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PREFACE.

To write a fairly complete systematic treatise on any branch of medicine demands from the writer a very wide experience of his own, a large acquaintance with the work of others, considerable industry, and a critical faculty that will enable him to draw sound conclusions and precepts from his survey of the subject.

A sense of the difficulty of the task demanding such qualifications has long deterred the senior author of this book from publishing a treatise on Obstetrics. He has, indeed, travelled, in practice, teaching, discussion, and writing, over almost every step of the ground. A very considerable part of the field is covered in the "Obstetric Operations," a work which has probably exercised a greater influence than any other over practice in difficult midwifery. And this work—so rapid are the advances in the art—now requires revision. Moreover, when any one part of obstetrics is detached from the rest, it is necessarily maimed. To comprehend rightly the science, and to grasp fully the principles of its practice, all the several parts must be studied in their correlation and solidarity.

Another reason has had weight in stimulating the production of this work. It is a matter of observation that original work scattered in monographs often brings less credit to the authors than it does to those who possess the gift of assimilating it, and of reproducing it in the more attractive and convenient form of a "system." In these days, the student and practitioner are often too busy, if not too indolent, to indulge in research. This book, then, affords us opportunity of revindicating not a few claims to priority which have been attributed to more or less unconscious borrowers.

Still, impelled as we were by the conviction that the time had come when we ought to give effect to a long-cherished design to write a systematic treatise on Obstetrics, that design would in all probability never have been carried into execution but for the fortunate association of father and son, of teacher and pupil, in the task.

The share which each of the fellow-workmen has had in the structure will be in many cases indicated by individual references. It may be stated generally that the history of gestation, of puerpery, of the mechanism of labor and of hemorrhage, is chiefly contributed by Robert Barnes, whilst much of that which relates to the prophylaxis of puerperal diseases, and the description of the operations, is contributed by Fancourt Barnes. Still,

the work is essentially a joint production; neither could have done it alone; and still we have found it necessary to call in further assistance.

The systematic writer on Obstetrics naturally begins *ab ovo*, and thus we were met by a difficulty at the very threshold. No man can hope to master the facts and science of Embryology unless he spend several hours a day in the physiological laboratory. Such steady devotion of time and thought cannot be spared by those who are involved in the toils of obstetric practice. We, therefore, at once confess our inability to treat this subject in such a way as to give an adequate picture of it, capable of throwing full light upon the outflowing physiological and pathological problems. Not to waste precious time wanted to do justice to those topics which lay within our capacity, and not willing to descend to the drudgery of compilation, we sought the assistance of a master of the subject. Future authors will certainly follow our example. Our readers will thank us for having enlisted the services of Professor Milnes Marshall for this department.

We may here appropriately introduce some general remarks from him bearing directly upon our text:

"It is usual," he says, "in works on Obstetrics to omit all reference to the earliest known stages of embryology, but we preferred a different course. No one will dispute that a proper knowledge of the early phases of human development is very important, yet if this study continue to be systematically ignored by those who alone have opportunities of extending our knowledge in this direction, what hope can there be of our completing it? The requisite specimens are difficult to obtain; they only turn up on rare occasions. This difficulty renders it more incumbent upon everyone to whom the opportunities are likely to fall to be fully alive to the importance of making the most of them. The actual number of specimens less than a fortnight old that have been described with any degree of accuracy is surprisingly small. There can be little doubt that opportunities are frequently missed, and valuable specimens lost, simply through failure to appreciate their true value, and insufficient care in examining and preserving objects of great delicacy."

To this argument, in itself unanswerable, we may add that in this elemental study we may now and then catch a luminous glimpse, if not a full explanation, of many things that come before us in clinical practice, which will not only throw around our work the enchantment of scientific research, but which may one day develop into the fulness of knowledge.

The study of the so-called malformations and diseases of the embryo is one of the most obvious illustrations of this argument. The only hope of understanding these and the cognate deviations from the standard structural development of father and mother, and other racial problems, must rest on the profound study of embryology. Again, with this view of placing the leading points of what we know in teratology, with especial reference to classification and clinical practice, we have sought the aid of Mr. Noble Smith, who has done so much to place Orthopædic Surgery on a sound and scientific basis.

The immediate purpose of the work is, in the words of the title-page, to serve as a handbook of Obstetric Medicine and Surgery for the use of the student and practitioner. We trust that the work will at least justify its title. But we indulge a hope beyond this. Just as it is impossible to attain to the right appreciation of any particular department of obstetrics if taken up by itself, neglecting the study of its mutual relations to the science as a whole, so it must be impossible to attain to the right appreciation of many of the great problems in general medicine and surgery if the increasing and reverberating light which the careful study of obstetrics can throw upon them be shut out. Obviously the converse is equally true. This means that obstetrics is not a specialty. It is an integral constituent of the great art of healing. He only deserves to be set down as a specialist who narrows his field of vision by the limits within which the prejudices transmitted by ignorance and arbitrary custom would bind him. The real specialist, in short, is he who, specially directing his attention to one factor of a medical problem, specially neglects to take note of the correlated factors. Tried by this test, the physician or surgeon who undertakes to treat a case of apparent nervous disease in a woman, neglecting all the while to ascertain the condition of the dominating organs in the pelvis, is a specialist. So, on the other hand, that gynecologist is a specialist who, dealing with a real or apparent disease in the pelvis, neglects the aid which an enlarged study of general pathology might reflect upon the immediate problem before him. And since diagnostic and therapeutical skill are inseparable, so is he a hopeless specialist who consents to conduct a case a part of the way only, calling in a special surgeon to complete the treatment. To make a particular application of the old maxim, "Curatio ostendit morbum," it may be said that the surgical operation which crowns the treatment is often the most instructive element in the case. To abandon this source of knowledge is to contract at once the means of cultivating pathological knowledge, diagnostic power, and therapeutical skill. The obstetrist is, of necessity, a surgeon as well as a physician.

The leading idea in the arrangement of this work has been to pursue a natural order, based on the sequence or evolution of the processes of gestation, parturition, and puerpery. To realize fully this idea is a difficulty which everyone who has tried to write a systematic work on any subject will readily acknowledge. It is impossible to adhere rigidly to any plan without repetition and overlapping, or without in some instances breaking up a subject which would be better understood if studied in its entirety. And, again, it is often impossible to present fairly the special topic under discussion without introducing episodical illustrations drawn from topics not strictly connected. For example, hemorrhage occurs during gestation, labor, and childbed. Although certain characteristic differences mark the hemorrhages in each of these periods, these differences are better seized when described in direct contrast. The fundamental laws which govern all hemorrhages will thus stand out in more instructive prominence. Yet obedience to this order imposes this dilemma: either to omit from the history of gesta-

tion more than a provisional indication of the hemorrhages which occur during that period, or to introduce in its seemingly natural place a full account of these hemorrhages, and then to repeat that account when tracing the connected history of hemorrhage.

Many new illustrations will be found. We have been careful to give the source whence the borrowed ones are taken, and have appended our names to those drawn by ourselves.

As to the manner in which we have acquitted ourselves of an arduous task it is not for us to say more than that we have striven to do conscientiously what we have undertaken. The reader in search of instruction, and the critic in search of matter for praise or censure, will determine for themselves what measure of success has been achieved.

ROBERT BARNES,
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THE DISEASES OF WOMEN.

CHAPTER I.

THE OVUM.

THE PRÆGRAVID STATE—PRIMITIVE OVA—THE PERMANENT OVA—THE GRAAFIAN FOLLICLE—THE RIPE OVARIAN OVUM—CORPUS LUTEUM—DEVELOPMENT OF THE OVUM—OVULATION.

MAN, like the vast majority of animals, is developed from an egg or *ovum*. This ovum, formed within the ovary of the female parent, is at a very early period set free from the ovary, and passing along the oviduct reaches and becomes lodged in the uterus; within which it remains for a period of about nine months, undergoing the complicated series of changes by which the ovum is converted into the embryo, and the embryo gradually built up and fashioned into the human form.

The present chapter is concerned with the earliest of this important series of events—the mode of formation of the ovum and the changes which it undergoes up to the time of leaving the ovary; together with which it will be convenient to consider certain other processes which accompany or are closely connected with the maturation of the ova.

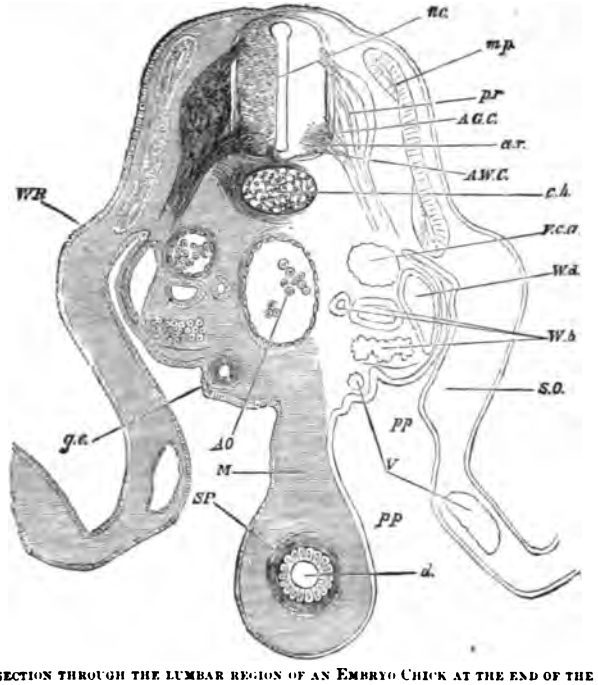
In order to gain a satisfactory knowledge of the development of the human ovum, it is by no means sufficient to examine the ovary of an adult woman or even of a child, for almost all the earlier stages of this development are already accomplished long before birth, and although in a female child the formation of ova does go on after birth, yet it only does so for a very short time and to a very limited extent. Indeed, it would appear from the researches of Bischoff, Waldeyer, Foulis, and others, that the formation of new ova ceases about the age of two years; in other words, that the ovaries of a female child already contain, at the end of the second year, all the ova that will ever be developed in them.

For this reason it is necessary to commence, not with the ovary of a woman or child, but with that of the embryo, at a very early period of its existence.

The ovaries appear in the human embryo at about the fifth week as a pair of longitudinal ridges lying one on either side of the mid-dorsal line of the abdominal wall, and close to the inner sides of the Wolffian bodies or primitive kidneys. Each ridge is formed by a slight local thickening of the epithelial layer which lines the peritoneal or body-cavity, supported by a low ridge of connective tissue. The relations of these primitive ovaries or genital ridges, as they may be called, are shown in Fig. 1, which represents the corresponding stage in the development of the chick.

The epithelium covering the ridge, which we shall henceforth speak of as the *germinal epithelium*, Fig. 1, *g e*, is directly continuous with the peritoneal epithelium lining the body-cavity, of which it is, indeed, a part. It is at first perfectly similar to the rest, but at an early age becomes distinguished from it by its component cells acquiring a columnar shape, and so creating the prominence we have called the genital ridge. This primitive continuity

FIG. 1.



TRANSVERSE SECTION THROUGH THE LUMBAR REGION OF AN EMBRYO CHICK AT THE END OF THE FOURTH DAY. (From BALFOUR.)

A.G.C. Anterior gray column of spinal cord. *A.O.* Dorsal aorta. *a.r.* Anterior root of spinal nerve. *A.W.C.* Anterior white column of spinal cord. *c.h.* Notochord. *d.* Alimentary canal. *g.e.* Germinal epithelium covering genital ridge. *M.* Commencing mesentery. *m.p.* Muscle plate. *n.c.* Neural canal. *pp.* Pleuroperitoneal cavity. *p.r.* Posterior root of spinal nerve with ganglion. *S.O.* Somatopleure. *S.P.* Splanchnopleure. *V.* Bloodvessels. *V.c.a.* Posterior cardinal vein. *W.b.* Wolffian body. *W.d.* Wolffian duct. *W.R.* Wolffian ridge.

between the germinal epithelium, which we shall find gives rises directly to the ova, and the peritoneal epithelium lining the body-cavity, is well shown in Fig. 1.

As the embryo grows older the genital ridges gradually become pinched off from the abdominal wall, and acquire the definite shape and character of ovaries; the *hilum*, or groove by which the vessels and nerves enter, marking in each the part where the attachment persists longest. Each ovary consists of an external investment of epithelium—the *germinal epithelium*—and a central core of connective tissue, containing numerous blood-vessels derived from the dorsal wall of the abdomen and entering at the *hilum*. As we have already stated, and as is shown in Fig. 1, the genital ridges are at first situated very close, indeed, to the primitive kidneys or Wolffian bodies, and during the early stages of development the connection

between the two structures is made still closer by means of a number of rod-like outgrowths from the Malpighian bodies of the kidneys, which later on become hollow, and form the so-called "tubuliferous tissue" of the ovary. This tubuliferous tissue lies at first immediately beneath the germinal epithelium, but soon becomes separated from it by a layer of connective tissue, and so becomes confined to the central portion of the ovary; it has nothing whatever to do with the ova, and merely requires mention here on account of its great prominence, especially during the earliest stages of development.

Of the two other elements composing the ovary—viz., the germinal epithelium and the connective-tissue core or stroma—the former is the more important, as from it the ova are directly developed, the connective tissue serving mainly to divide the several groups of ova from one another, and to support the bloodvessels which carry nutrient matter to the different parts of the ovary, and remove from them the effete products resulting from their growth and activity. It is, therefore, with the germinal epithelium that we have mainly to deal.

In its earliest stages this germinal epithelium consists of a single layer of columnar epithelial cells with large nuclei, the cells measuring on an average about 0.014 mm. in length by 0.007 mm. wide. By repeated division of its component cells the epithelium increases rapidly in thickness, and soon forms a layer several cells thick, whereof the most superficial ones still preserve their columnar form, while the deeper ones are mostly of an oval shape.

Whilst the epithelial cells are thus rapidly multiplying, the connective-tissue stroma is also undergoing active changes; it gives off processes which grow in between the cells of the deeper layers of the epithelium, and so break this up into a series of irregularly branching rods—the so-called "egg columns." By a continuation of this process the epithelium becomes completely honeycombed by the stroma, which is accompanied by the bloodvessels wherever it penetrates; so that, in place of the original arrangement of a layer of epithelium clothing a central connective-tissue core, we now have a superficial layer of columnar epithelium, beneath which is a framework of vascular connective tissue, the meshes of which freely communicate together, and are filled with columns or "nests" of epithelial cells.

Primitive Ova.—The epithelial cells, at first all pretty nearly the same size, do not long remain so; at a very early period certain of them become conspicuous by their larger size and more spherical shape, and these large round epithelial cells with big nuclei are very important things; they are the *primitive ova*, each one of which is capable of developing into a definitive or *permanent ovum*, and so of giving rise to an embryo. Each one of these epithelial cells is, in fact, a potential human being.

These primitive ova occur both in the superficial layer of columnar epithelium and in the more deeply situated nests of epithelial cells that are cut off and invested by the trabeculæ of the vascular stroma. In these nests a tendency soon manifests itself for the smaller epithelial cells to arrange themselves around the primitive ova, and so enclose them in follicles. At first there may be in a single nest several of these follicles, each containing an ovum, but the continued growth of the connective-tissue stroma gradually breaks up the nests, and tends to isolate the several follicles from one another, forming round each one a separate connective-tissue investment.

We are now in a position to understand the structure of the ovary at the time of birth. Fig. 2 represents a vertical section through the superficial portion of the ovary of a newly born child. It shows the surface layer of columnar epithelium—the germinal epithelium—which is now separated from the deeper portions by a thin layer of connective tissue, the *tunica*

albuginea. A little deeper we see large nests of epithelial cells, which are really the deeper portions of the germinal epithelium cut off and isolated from one another by the growth of the connective-tissue stroma: in these nests certain of the cells—the ova—are distinguished by their larger size, and around these the smaller cells tend to arrange themselves so as to form capsules or follicles. In the deeper parts of the ovary the continued growth of the stroma, which is abundantly supplied with bloodvessels, has divided up the nests and more or less completely isolated the follicles from one another.

It will be noticed that in passing from the exterior towards the deeper parts of the ovary we meet with successive stages in the development of the ova. In the superficial layer of columnar epithelial cells we find the earliest stages; certain of these cells, the primitive ova, being of rather larger size than their neighbors. Beneath this surface layer we find large nests com-

FIG. 2.

PART OF A VERTICAL SECTION OF THE OVARY OF A NEW-BORN INFANT.
(From STRICKER'S *Histology*) × 150.

a. Superficial layer of columnar epithelium. *b*. Plate of epithelial cells formed by irregular growth of ovary. *c, c* Primitive ova. *d, e*. Nests of various shapes, containing many ova and commencing follicles. *f*. Isolated follicle. *g*. Bloodvessel.

posed of epithelial cells which, except in the larger size of the primitive ova, differ but little from one another and present no regularity of arrangement. In the more deeply placed nests the cells immediately adjacent to the ova have arranged themselves round these latter so as to form follicles, but there are still in such nests many cells of indifferent character, whose ultimate fate is uncertain. Deeper still we find the number of these indifferent cells very greatly diminished, and the follicles separated from one another by trabeculæ of the stroma. In such a section, therefore, the most deeply situated ova are the oldest and most mature, and have, in attaining their present position, passed through in succession the several stages which we encounter in passing from the surface to the deeper parts of the ovary.

Owing to the rapid and somewhat irregular growth of the germinal epithelium and the underlying stroma, the surface of the ovary, which at first is smooth, becomes raised into a number of irregular projections, separated from one another by deep grooves or wrinkles. These grooves in vertical

sections of the ovary have the appearance of tubular pittings-in of the surface epithelium, and have been by some writers erroneously described as tubular glands. By further growth of the ovary the two sides of such a groove may come in contact and fuse with one another, and the solid plate of epithelial cells so formed may, like other parts of the germinal epithelium, give rise to ova. An example of this is shown in Fig. 2, *b*.

The Permanent Ova.—About the time that the egg follicles or capsules commence to be formed around the primitive ova, these latter undergo certain changes by which they become converted into the *permanent ova;* and this transformation is one of no little importance, for primitive ova occur not only in female embryos, but in male as well, and in both give rise, though by a very different series of modifications, to the special generative products. The conversion of primitive into permanent ova marks, therefore, the establishment of the sexuality of the embryo.

The changes in question chiefly concern the nucleus. This, which in the primitive ovum is uniformly granular, and has a rather ill-defined outline, becomes converted into a spherical vesicular body, with a sharply defined double-contoured wall. Within this wall the granules, instead of being uniformly diffused, become collected into a small darkly staining knob attached to the wall at one spot, the rest of the vesicle being filled with a transparent colorless fluid. The granular knob soon gives out processes, and so becomes stellate; and, by the processes branching and anastomosing, becomes converted into a delicate reticulum or network stretching all through the nucleus. The crossing points or nodes of the network are somewhat enlarged, and at one or sometimes two or more places become specially prominent, forming highly refracting bodies—the *nucleoli*. In this way from the nucleus of the primitive ovum are derived the nucleus, or, as it is more commonly called, the *germinal vesicle*, and the nucleolus or *germinal spot* of the permanent ovum.

Certain other changes which occur about the same time are probably less intimately concerned with the formation of the permanent ovum. The whole egg increases in size; its protoplasm, which was previously clear, becomes granular; and round the outside of the ovum a thin investing membrane, the vitelline membrane or *zona pellucida*, is formed.

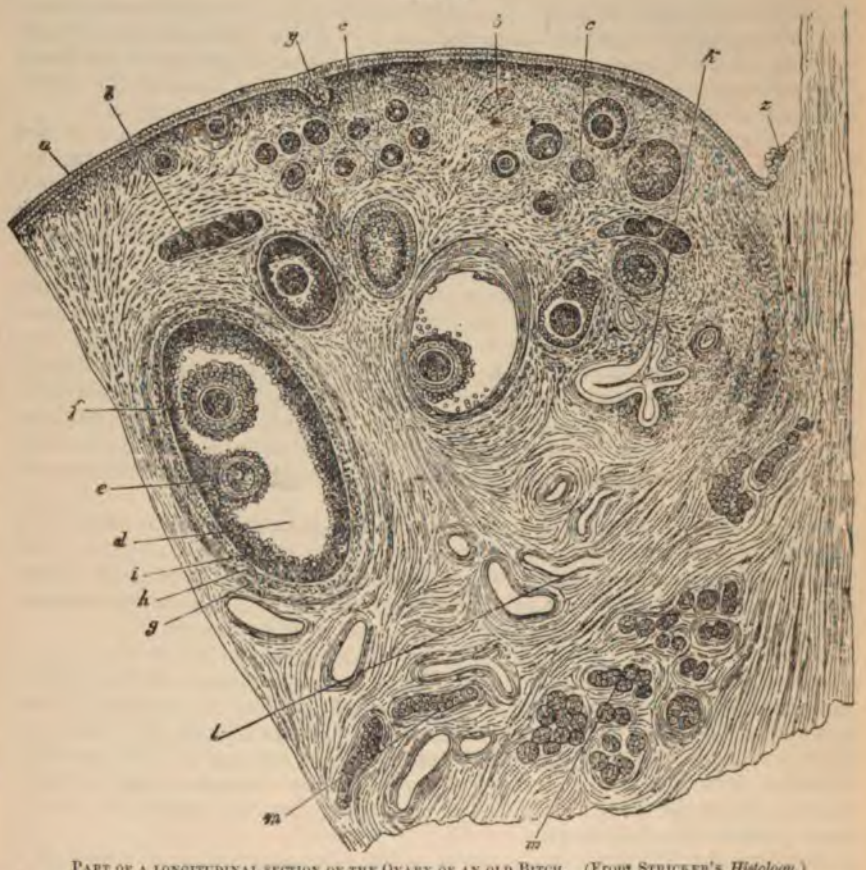
Certain exceptions to the normal course of events as described above may occur in the development of the ova. Thus, in many animals, as the rabbit, and very probably in the human ovary as well, some of the primitive ova, instead of becoming directly converted into permanent ova, may fuse up together so as to form multinuclear masses of protoplasm. Of the nuclei, which at first increase in number, some ultimately disappear, while others become converted into the nuclei of permanent ova, into which the whole mass becomes finally divided.

The Graafian Follicle.—Each ovum, as we have seen, becomes closely surrounded by a follicle or capsule formed of a single layer of cells; these follicular epithelial cells being, like the ovum itself, derived from the original germinal epithelium.[1] It may happen that two or even more ova may be enclosed in a single follicle, but this is exceptional, and when it does occur is usually only temporary; the connective-tissue stroma, later on, growing in between the ova and so separating them from one another. As a rule, each ovum has its own investment of epithelial cells, forming the commencement of what is known as the Graafian follicle. The follicular epithelium forms at first a single layer

[1] Foulis maintains that the follicular cells are derived from the connective-tissue stroma. Balfour's observations on the rabbit's ovary appear, however, to be conclusive against this view.

of short columnar cells, with an average length of 0.008 mm., and of very granular appearance, applied very closely to the ovum which they surround. As the ovum begins to grow rapidly directly after the follicle is established, and as any nutrient matter reaching the ovum can only do so by first passing through the follicular epithelial cells, it is clear that these cells must play a very important part in the nutrition of the ovum; and their main function is probably that of transmitting food from the bloodvessels of the

FIG. 3.



PART OF A LONGITUDINAL SECTION OF THE OVARY OF AN OLD BITCH. (FROM STRICKER'S *Histology*.)

a. Superficial layer of columnar epithelium. *b, b*. Nests. *c, c*. Young follicles. *d*. Older follicle. *e*. Discus proligerus, with embedded ovum. *f*. Second ovum in the same follicle. *g*. Tunica fibrosa folliculi. *h*. Tunica propria folliculi. *i*. Membrana granulosa. *k*. Collapsed, atrophied follicle. *l*. Bloodvessel. *m*. Part of parovarium. *y*. Plate of germinal epithelium formed by irregular growth of ovary. *z*. Passage of germinal epithelium into ordinary peritoneal epithelium.

stroma to the ovum, and very possibly elaborating that food to a certain extent as they pass it on. The granular appearance acquired by the protoplasm of the ovum, after establishment of the follicle, is due to the accumulation of food matter passed into it from these investing epithelial cells.

The follicular epithelium does not long remain a single layer; it rapidly increases in thickness, the cells multiplying by division and so forming a

layer several cells thick, the so-called *membrana granulosa;* at the same time the connective tissue immediately outside the follicle becomes modified so as to form a special outer investment, the *tunica propria* of the Graafian follicle, in which the bloodvessels are very strongly developed.

In the *membrana granulosa* the layer of cells immediately surrounding the ovum preserves its columnar character; while the remaining cells, which are usually smaller, are spherical or oval in shape.

Both the follicle and the ovum continue to increase in size, but the follicle grows far more rapidly than the ovum; in consequence of this a cavity, somewhat crescentic in shape, appears in the midst of the *membrana granulosa;* this follicular cavity, which is filled by a transparent fluid, the *liquor folliculi*, grows very rapidly, and the whole follicle soon acquires the shape and structure shown in Fig. 3.

In this figure, which represents a section through the ovary of a bitch, various stages in the development of the Graafian follicle are shown. The fully formed follicle, *d*, on the left side of the figure, is oval in shape; its walls consist of an outer vascular investment of connective tissue derived from the stroma of the ovary, and divisible, according to some authorities, into a rather ill-defined outer layer, the *tunica fibrosa folliculi*, and an inner well-marked layer of fine connective tissue with an abundant plexus of capillary bloodvessels, the *tunica propria folliculi*. Within this latter is the *membrana granulosa*, a thick layer of granular spherical (or, from mutual pressure, polygonal) cells. At one part the *membrana granulosa* is much thickened, forming a roundish mass projecting into the cavity of the follicle; embedded in the middle of this roundish mass, or *discus proligerus*, is the ovum, the layer of cells immediately surrounding it being distinctly columnar. The cavity of the follicle is filled by the watery *liquor folliculi*.

We have already seen that in the earlier phases of development of the ova the younger stages are found nearest to the surface of the ovary, and the older ones in the deeper portions, and Fig. 3 shows that the same holds good with regard to the later phases. The younger Graafian follicles, those in which the ovum is merely surrounded by a single layer of epithelial cells, are situated not far from the surface of the ovary; the older follicles are rather more deeply placed, and the oldest and most mature ones are the deepest of all.

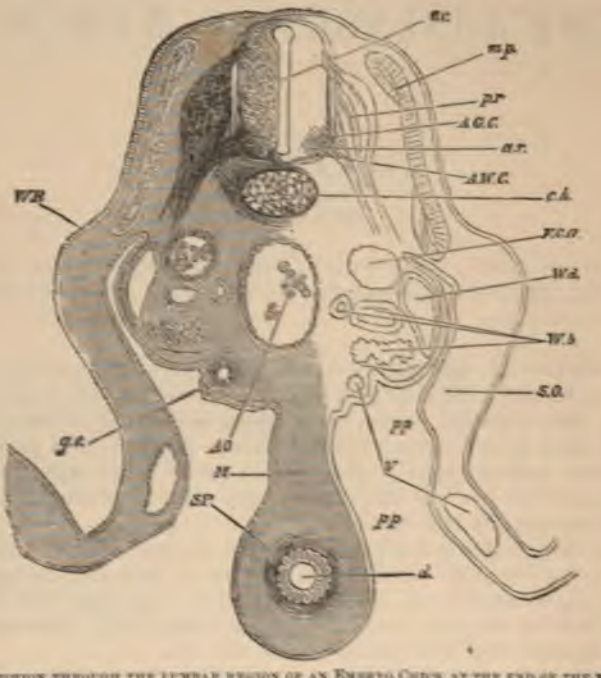
The *discus proligerus*, with its contained ovum, occupies no definite position in the Graafian follicle; formerly it was supposed always to lie on that side of the follicle which is nearest the surface of the ovary; but it is now known that this is not the case, and that the ovum is quite as often attached to the wall of the follicle furthest from the surface as to any other point.

The Graafian follicles do not stop at the stage figured and described above; they go on increasing in size, and as their growth is now mainly towards the surface of the ovary, their outer walls ultimately become situated close beneath this surface, or may even push the superficial layer of epithelium and connective tissue of the ovary before them, and so form slight external projections.

At the most prominent part of the ripe follicle is a small spot, the *hilum folliculi*, distinguished from the rest of the follicle by being devoid of bloodvessels. At this place, shortly after the follicle has attained its full dimensions—*i. e.*, a diameter of 1.25 to 4 mm. in the human ovary—rupture of the follicular wall occurs, and the ovum, together with the liquor folliculi, is discharged on the surface of the ovary. This rupture is due apparently to two causes; first, to extensive fatty degeneration of the cells composing the wall of the follicle; and, secondly, to the growth of folds of the *membrana granulosa* and *tunica propria* into the cavity of the follicle; thereby, owing

The epithelium covering the ridge, which we shall henceforth speak of as the *germinal epithelium*, Fig. 1, *g e*, is directly continuous with the peritoneal epithelium lining the body-cavity, of which it is, indeed, a part. It is at first perfectly similar to the rest, but at an early age becomes distinguished from it by its component cells acquiring a columnar shape, and so creating the prominence we have called the genital ridge. This primitive continuity

FIG. 1.



TRANSVERSE SECTION THROUGH THE LUMBAR REGION OF AN EMBRYO CHICK AT THE END OF THE FOURTH DAY. (From BALFOUR.)

A.G.C. Anterior gray column of spinal cord. *A.O.* Dorsal aorta. *a.r.* Anterior root of spinal nerve. *A.W.C.* Anterior white column of spinal cord. *c.h.* Notochord. *d.* Alimentary canal. *g.e.* Germinal epithelium covering genital ridge. *M.* Commencing mesentery. *m.p.* Muscle plate. *n.c.* Neural canal. *pp.* Pleuroperitoneal cavity. *p.r.* Posterior root of spinal nerve with ganglion. *S.O.* Somatopleure. *S.P.* Splanchnopleure. *V.* Bloodvessels. *V.c.a.* Posterior cardinal vein. *W.b.* Wolffian body. *W.d.* Wolffian duct. *W.R.* Wolffian ridge.

between the germinal epithelium, which we shall find gives rises directly to the ova, and the peritoneal epithelium lining the body-cavity, is well shown in Fig. 1.

As the embryo grows older the genital ridges gradually become pinched off from the abdominal wall, and acquire the definite shape and character of ovaries; the *hilum*, or groove by which the vessels and nerves enter, marking in each the part where the attachment persists longest. Each ovary consists of an external investment of epithelium—the *germinal epithelium*—and a central core of connective tissue, containing numerous blood-vessels derived from the dorsal wall of the abdomen and entering at the *hilum*. As we have already stated, and as is shown in Fig. 1, the genital ridges are at first situated very close, indeed, to the primitive kidneys or Wolffian bodies, and during the early stages of development the connection

between the two structures is made still closer by means of a number of rod-like outgrowths from the Malpighian bodies of the kidneys, which later on become hollow, and form the so-called "tubuliferous tissue" of the ovary. This tubuliferous tissue lies at first immediately beneath the germinal epithelium, but soon becomes separated from it by a layer of connective tissue, and so becomes confined to the central portion of the ovary; it has nothing whatever to do with the ova, and merely requires mention here on account of its great prominence, especially during the earliest stages of development.

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Whilst the epithelial cells are thus rapidly multiplying, the connective-tissue stroma is also undergoing active changes; it gives off processes which grow in between the cells of the deeper layers of the epithelium, and so break this up into a series of irregularly branching rods—the so-called "egg columns." By a continuation of this process the epithelium becomes completely honeycombed by the stroma, which is accompanied by the bloodvessels wherever it penetrates; so that, in place of the original arrangement of a layer of epithelium clothing a central connective-tissue core, we now have a superficial layer of columnar epithelium, beneath which is a framework of vascular connective tissue, the meshes of which freely communicate together, and are filled with columns or "nests" of epithelial cells.

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We are now in a position to understand the structure of the ovary at the time of birth. Fig. 2 represents a vertical section through the superficial portion of the ovary of a newly born child. It shows the surface layer of columnar epithelium—the germinal epithelium—which is now separated from the deeper portions by a thin layer of connective tissue, the *tunica*

on, at a time not determined with certainty, but probably towards the end of the second month, these primitive ova begin to be converted into permanent ova, the change consisting in an increase in size, and in certain important modifications in the structure of the nucleus. The permanent ova become enclosed in follicles formed by those epithelial cells which have not themselves become ova. The follicular epithelium serves to feed the enclosed ova, which grow rapidly; the permanent ovum when first formed having a diameter of about 0.012 mm., while the ripe ovum measures 0.2 mm.

Throughout the whole of fœtal life there is a rapid development of ova going on. At the time of birth each ovary of a female child has been estimated to contain at least 35,000 permanent ova. The formation of new ova continues for a short time after birth, but apparently ceases about the end of the second year, owing to the formation of the tunica albuginea, which cuts off the germinal epithelium from the deeper parts of the ovary.

Throughout the whole of the childbearing period of life there is a periodical ripening of the Graafian follicles and discharge of their contained ova by rupture, the times of discharge of ova corresponding to the menstrual periods. The ruptured follicles become filled by the structures known as *corpora lutea*, which disappear early if the escaped ovum be not fertilized, but undergo further development and persist throughout the whole period of pregnancy if the ovum be fertilized and develop into an embryo.

CHAPTER II.

THE FEMALE GENERATIVE ORGANS—THE EXTERNAL ORGANS OF GENERATION—THE INTERNAL ORGANS OF GENERATION—THE MENSTRUAL PROCESS, AND ITS ATTENDANT PHENOMENA.

It is usual to divide the female generative organs for descriptive purposes into two groups: (1) The external organs of generation—*i. e.*, the labia, nymphæ, clitoris, and other parts included in the vulva, together with the mons veneris; and (2) the internal organs—the ovaries, Fallopian tubes, uterus, and vagina.

I. The External Organs of Generation.

The Vulva.—The term *vulva* or *pudendum* is applied to the whole of the parts that are visible externally: these are the mons veneris, the labia, the nymphæ, the clitoris, and the hymen. These parts are chiefly concerned in copulation. With the perineum they perform a subordinate function in parturition.

The Mons Veneris (Fig. 5) is a slightly rounded eminence in front of the pubic symphysis, caused by an accumulation of very dense connective tissue and fat beneath the skin. From the time of puberty it is covered with hair.

Labia Pudendi.—The labia (Fig. 5), called also labia majora or labia externa, to distinguish them from the nymphæ, are two rounded folds of integument, forming the lateral boundaries of the vulva, and extending from the mons veneris in front to the perineum behind. Between them is an elliptical space, the *rima*, within which is the entrance to the vagina. The anterior ends of the two labia unite together behind the mons veneris to form the anterior commissure; and the hinder ends are sometimes described as uniting in a similar manner to form a posterior commissure; this latter, however, is indistinguishable from the perineum. The hinder ends of the two labia are also connected together by a thin transverse fold—the *fourchette*, or *frænulum pudendi*—situated, in the ordinary erect posture, just above the "posterior commissure," and separated from it by a transverse groove—the *fossa navicularis*. The fourchette, which is very thin, is commonly torn during parturition in primiparæ, if it has escaped obliteration in sexual intercourse.

The labia are covered on their outer surfaces with skin which bears hair, and on their inner surfaces with mucous membrane. At their bases are the *constrictores vaginæ* muscles. The two labia are normally in contact with one another, but shrink somewhat with age and so expose the other parts of the vulva.

The Perineum extends from the anus to the posterior commissure, which latter is merely its anterior border; it is usually about an inch and a half in length, but undergoes considerable distention during labor.

The Nymphæ (Fig. 5), called also *labia minora* and *labia interna*, are a pair of narrow folds of mucous membrane lying along the inner sides of the labia majora. In front the two nymphæ are linked together across the middle line, both above and below the clitoris; forming the *præputium clitoridis* and *frænum clitoridis* respectively. Posteriorly they gradually diminish in width, and end opposite the middle of the vaginal orifice.

Beneath the prepuce and along the outer surfaces of the nymphæ are sebaceous glands secreting an unctuous and odorous substance.

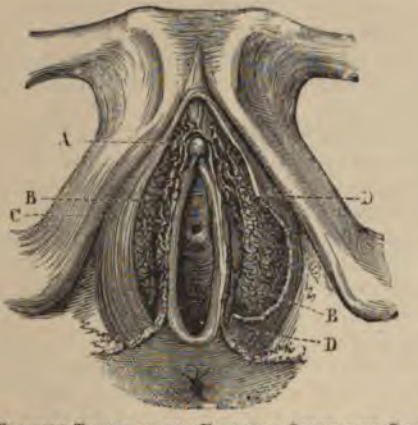
The Clitoris (Fig. 5) is a small elongated body corresponding to the penis of the male, and about an inch and a half in length, situated immediately behind the anterior commissure. The greater part of its length is hidden by the folds of mucous membrane just described, but the slightly

Fig. 5.

dilated extremity, the glans clitoridis, projects freely from between the prepuce and the frenum clitoridis. The clitoris consists of two corpora cavernosa united together along the median line; these diverge at the base to form the two crura, which are attached to the rami of the pubes and ischia.

VESTIBULE.—The term vestibule (Figs. 5 and 6) is usually applied to the triangular patch of mucous membrane situated in front of the vagina and between the two nymphæ. Its apex is formed by the clitoris, its sides by the inner edges of the nymphæ, and its base by a horizontal line drawn across the anterior edge of the vagina: the most important structure in it is the *meatus urinarius*, or orifice of the urethra (Fig. 5), situated at the base of the vestibule in the median line, less than an inch behind the clitoris. Two guides lead to it—(1) from behind, by tracing the anterior wall of the vagina forwards until the finger reaches its termination in a small tubercle —in this tubercle is the meatus; (2) tracing backwards from the clitoris between the nymphæ, the finger equally reaches the tubercle. In the mucous membrane of the vestibule, as well as along the inner surfaces of the nymphæ, are numerous mucous follicles.

FIG. 6.



THE ERECTILE TISSUES OF THE EXTERNAL GENERATIVE ORGANS.
(FROM TARNIER.)

A. Clitoris. B, B. Bulbi vestibuli. C, D. Right and left halves of the constrictor vaginæ muscle.

THE HYMEN.—The orifice of the vagina is in the virgin partially closed by a thin membranous duplication of the mucous membrane, which forms a kind of diaphragm—the *hymen*—pierced by an oval aperture, which is usually nearer to the anterior than to the posterior end. [Budin (1879) disputes the correctness of this, the common description of the hymen. He contends that dissection shows that the walls of the vagina are quite isolable and terminate in front by a perforated hemispherical part which is the prolongation of the columnæ of the vaginal mucous membrane which clothes the internal surface and which reaches to the orifice of the hymen. Histological examination aids in proving that the hymen is nothing more than the anterior extremity of the vagina covered outside by the mucous membrane of the vulva.—R. B.] The hymen is subject to considerable individual variations: it is not unfrequently absent in front, in which case it takes the form of a semilunar fold, with the concavity directed forwards; it may be perforated by more than one aperture, and may also be reduced to a mere fringe. In rare cases it is stronger than usual, and completely closes the vagina, giving rise to the condition known as imperforate hymen.

The hymen is nearly always lacerated, either radially or concentrically, by sexual connection, and at the birth of the first child becomes obliterated, or else reduced to a series of small fleshy projections—the *carunculæ myrti-*

formes—usually more abundant round the posterior margin of the vaginal aperture.

The *glands of Bartholin* or *of Duverney*, which correspond to Cowper's glands in the male, are two small bodies about the size of peas placed at the sides of the vagina. Each gland has a duct of some length, which opens on the inner surface of the nympha outside the hymen, and about opposite the middle of the vaginal orifice. They freely secrete a viscid mucus under excitement and in labor.

All the parts of the vulva are abundantly supplied with *bloodvessels*. The superficial pudendal arteries supply the outermost parts, while the deeper parts receive their blood from the internal pudic arteries. The venous plexuses of the bulbi vestibuli, partes intermediæ, corpora cavernosa, and glans clitoridis, give these parts the character of erectile tissue.

The *vulvar orifice*, through which the child emerges into the outer world, is bounded at the sides by the labia majora, behind by the fourchette, and in front by the vestibule, which becomes folded on itself at the time. Laceration of any one of these parts may occur in the act of parturition. Laceration of the vestibule is chiefly dangerous from the close proximity of the very vascular structures just noticed, and the consequent liability to profuse hemorrhage.

The Female Urethra.—Though not forming, strictly speaking, part of the female generative organs, it is convenient to insert here a short account of the female urethra, on account of its intimate connection with these organs.

From the *meatus urinarius*, whose position has been described above, the urethra passes upwards behind the symphysis pubis as a short tube about 3 cm. in length, and 7 mm. in diameter, but capable of considerable distention. The urethra, as shown in Fig. 7, is slightly curved, the concavity of the curve being directed forwards.

II. The Internal Organs of Generation.

The Vagina is the tubular passage leading from the uterus to the vulva. It is situated, as shown in Fig. 7, between the bladder and urethra in front and the rectum behind, being firmly connected with the former, but only loosely with the latter, and is enclosed laterally by the *levatores ani* muscles.

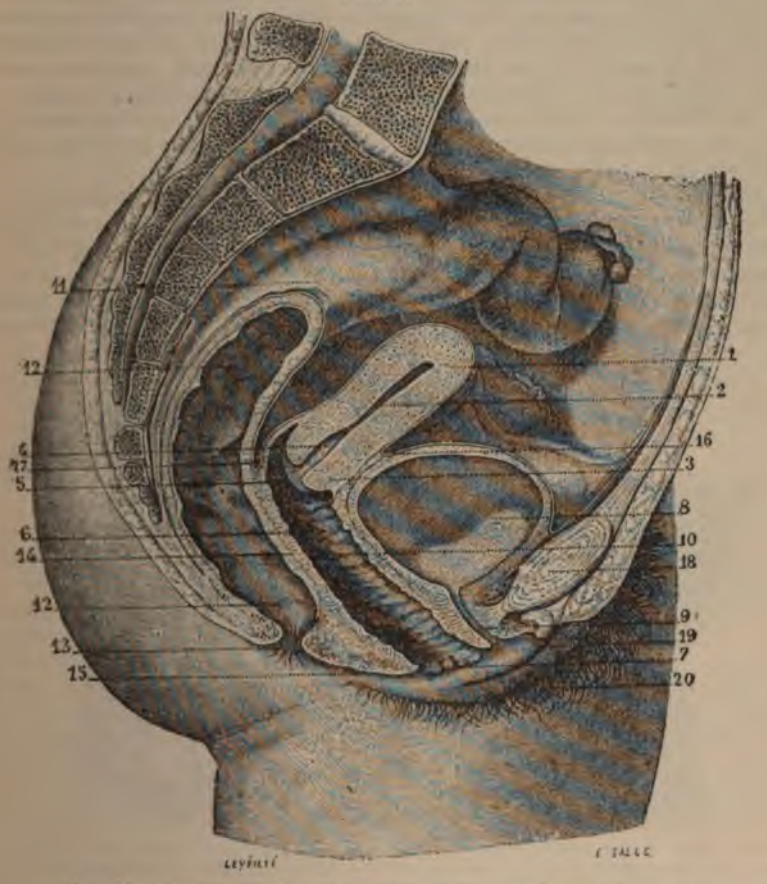
It is curved as shown in the figure, the concavity being directed forwards, and the anterior wall, which is about 10 cm. long, being 2 cm. or more shorter than the posterior wall. The upper part of the posterior wall, as shown in Fig. 7, is covered directly by the peritoneum, which descends between the vagina and rectum to form a cul-de-sac, usually spoken of as the *pouch of Douglas*. The widest part of the vagina is at the fundus; behind the insertion of the uterus is a more expanded part called the *upper* or *posterior pouch* or *cul-de-sac* of the vagina. In normal conditions the pouch is small, and its walls are in contact; but in women who have borne children, or who have been the subjects of sexual intercourse, or of retroversion or retroflexion of the uterus, this pouch becomes greatly enlarged. The vagina narrows towards the vulva, where it is constricted by the vulvar sphincter; in the normal state its anterior and posterior walls are in contact with one another so as to obliterate the cavity. On the inner surface of the vagina, both on the anterior and posterior walls, slightly elevated ridges, the *columnæ rugarum*, run upwards in the middle line, and from these lateral ridges or *rugæ* run off at right angles: both columns and rugæ are more distinct at the lower end of the vagina, and in those who have not borne children.

The walls of the vagina consist of three coats: (1) an inner mucous coat; (2) a middle muscular; (3) an outer fibrous.

1. The *mucous coat* is covered by an epithelial layer, which is squamous. It was long thought that the vaginal mucous membrane was rich in mucous

follicles, but anatomists now agree that it is destitute of glands. This mucous membrane, if exposed to the external air, very quickly takes on the characters and appearance of the external skin, becoming dry, and in black women pigmented, like the external genitals. At the upper end of the vagina the mucous membrane is reflected round the neck of the uterus, which (Fig. 7) projects some distance into the vagina. The part of the uterine neck thus projecting is distinguished as the *vaginal portion*.

FIG. 7.



THE FEMALE GENERATIVE ORGANS, AS SEEN IN LONGITUDINAL VERTICAL SECTION.
(From TARNIER, after SAPPEY.)

1. Body of uterus. 2. Cavity of body. 3. Cervix uteri. 4. Cavity of cervix. 5. Os uteri. 6. Cavity of vagina. 7. Vaginal orifice. 8. Bladder. 9. Urethra. 10. Vesico-vaginal wall. 11. Rectum. 12. Cavity of rectum. 13. Anus. 14. Recto-vaginal wall. 15. Perineum. 16. Vesico-uterine cul-de-sac. 17. Recto-vaginal cul-de-sac. 18. Symphysis pubis. 19. Nymphæ. 20. Labium majus.

2. The middle coat consists mainly of non-striated muscle, arranged, though not very distinctly, in internal circular and external longitudinal layers. These fibres are inserted in front into the ischio-pubic rami, and are continuous above with the fibres of the middle layer of the uterus.

3. Outside the muscles is a layer of loose erectile tissue, into which elastic

fibres enter largely. This structure accounts for the great distensibility of the vagina, and the readiness with which it recovers its contracted state.

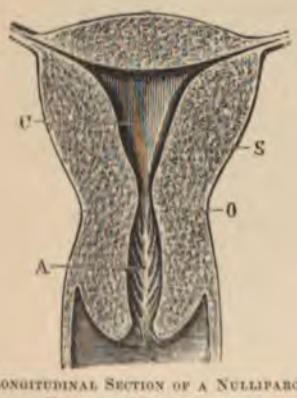
The vulval orifice of the vagina is surrounded by striated muscular fibres, forming the *sphincter vaginæ* muscle.

The vagina is very vascular, its blood being derived from the vaginal, internal pudic, vesical, and uterine branches of the internal iliac artery. The veins are numerous and large; they form several plexuses, taking their points of departure from the bulb and continuous with the veins of the uterus. They empty themselves into the venous plexuses at the sides of the vagina and terminate in the hypogastric veins. The lymphatic vessels run to the lateral glands of the pelvic cavity. Those of the inferior fourth of the vagina, however, unite with those of the vulva, and run with them to the inguinal glands. The nerves come from the hypogastric plexuses.

The Uterus is a hollow muscular organ lying (Fig. 7) between the bladder and the rectum, and inserted somewhat obliquely into the top of the vagina, with which its cavity communicates.

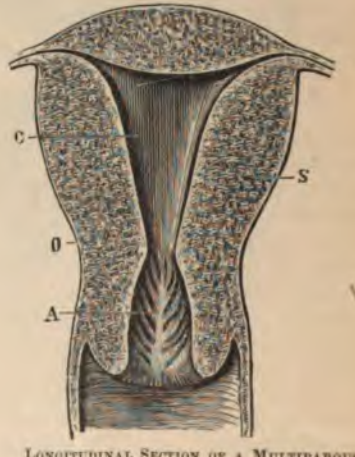
The uterus is of the shape of a somewhat flattened pear, measuring about 7 cm. in length, 5 cm. in width from side to side, and 2.5 cm. in thickness from before backwards. It is divided into an upper part or body, the rounded extremity of which is termed the *fundus*, and a lower part, or *cervix:* the boundary between the two being indicated by a slight external constriction, but being far more strongly marked internally both by an internal

FIG. 8.



LONGITUDINAL SECTION OF A NULLIPAROUS UTERUS. (After TARNIER.)

FIG. 9.



LONGITUDINAL SECTION OF A MULTIPAROUS UTERUS. (After TARNIER.)

A. Cavity of the cervix and arbor vitæ. C. Cavity of the body. O. Constriction between body and cervix, the *os uteri internum*. S. Wall of fundus.

constriction—the *os uteri internum*—and by a very sudden alteration in the character of the lining membrane. These two parts may conveniently be dealt with separately.

The cervix is about 2.5 cm. in length: its walls (Fig. 8) are thick, and its cavity somewhat fusiform in shape, being wider in the middle and narrowed towards both ends. The cavity opens below by the *os uteri externum* or *os tincæ* into the vagina, and above by the *os uteri internum*, which is smaller than the *os externum*, into the upper portion or body of the uterus.

The lower or *vaginal portion* of the cervix projects, as shown in Fig. 7,

into the vagina: owing to the oblique character of its insertion, the anterior lip of the os externum, though the shorter one, reaches lower down the vagina than the longer posterior lip. It is of great practical importance to realize thoroughly this oblique insertion of the *cervix uteri* into the vagina, because owing to it the os uteri appears, on digital examination, to be in the anterior wall of the vagina, and not at its summit. The os uteri itself is a small transverse slit, whose margins are in the healthy state perfectly smooth.

The mucous membrane lining the cervix, which is continuous at the os externum with that of the vagina, is very firm, and is marked on its anterior and posterior surfaces by median longitudinal ridges, from which lateral ridges, or *rugæ*, run obliquely upwards on each side; the median ridge, with its diverging rugæ, receiving the name *arbor vitæ uterinus* (Figs. 8 and 9). The anterior arbor vitæ is usually more strongly marked than that of the posterior wall.

The epithelium of the cervical mucous membrane is columnar and ciliated, the cells becoming flattened and losing their cilia towards the *os externum*. Between the rugæ of the arbor vitæ are numerous simple follicular glands which secrete a viscid, transparent, alkaline mucus, which becomes increased in quantity during pregnancy, forming a plug completely blocking up the cavity of the cervix. Besides these glands there are, in the lower part of the cervix, numerous vascular papillæ.

The substance of the wall of the cervix consists chiefly of non-striated muscle, divisible into an internal layer, in which the muscle-fibres are arranged transversely or slightly obliquely, and which is thickened at both the os externum and os internum to form the so-called sphincters of these orifices; and an external layer, which is thinner, and in which the fibres run longitudinally.

The peritoneum (Fig. 7) covers the whole of the posterior surface of the cervix, excepting, of course, the part that projects into the vagina, but on the anterior surface it covers merely the uppermost part, being reflected off about the level of the os internum, below which point the proper tissue of the vagina is directly continuous with the wall of the bladder. The anterior surface of the uterus is flat; the posterior wall is convex, in harmony with the concavity of the sacrum.

The body of the uterus is shown in sagittal section in Fig. 7—*i. e.*, the plane of section is the median vertical plane of the whole body; while in Fig. 8 it is shown bisected longitudinally, so as to show the internal cavity. This cavity is seen to be triangular from side to side, and flattened from before backwards; its anterior and posterior walls being in the unimpregnated condition in contact, or almost so, with one another. It communicates below by the os internum with the cavity of the cervix, and above on either side with the cavities of the Fallopian tubes or oviducts.

The mucous membrane lining the body of the uterus is, when the uterus is at rest, smooth, and of a soft spongy consistence and pale red color; it is separated at the os internum by a very sharp line of demarcation from the mucous membrane of the cervix.

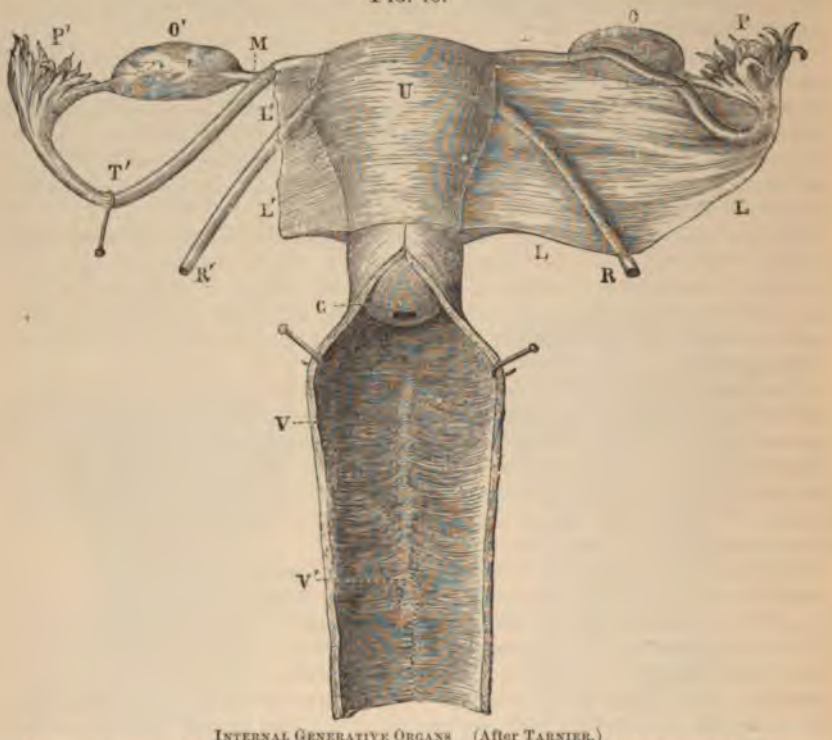
The structure of the mucous membrane of the uterus has been the subject of much dispute.

According to Ercolani, the lining membrane of the body of the uterus consists of a single layer of ciliated epithelial cells resting on an extremely delicate basement membrane. In this epithelium are a number of small holes, the orifices of the utricular glands, which are simple tubular glands lined by a ciliated epithelium, continuous with that of the uterine cavity, and having an average length of about 1 mm. These glands may branch at their outer cæcal ends, but as a rule do not do so while the uterus is in a

quiescent state. Between the glands are irregularly arranged muscular fibres with connective-tissue cells of various forms and sizes. The whole stratum, made up of the glands and the intervening connective and muscular elements, is spoken of by Ercolani as the musculo-glandular layer of the wall of the uterus; it has a total thickness of from 1 mm. to 1.8 mm., thinning as it approaches the os internum and the apertures of the Fallopian tubes.

By most writers the epithelium and basement membrane on which it rests, together with the musculo-glandular layer, are together spoken of as forming the mucous membrane of the uterus. Ercolani, however, objects to the use of the term mucous membrane at all as applied to this lining membrane of

FIG. 10.



INTERNAL GENERATIVE ORGANS (After TARNIER.)

The broad ligament of the right side has been partially removed, and the vagina laid open by a median longitudinal incision along its anterior wall.

C. Cervix uteri. L. Broad ligament of left side. L'. Broad ligament of right side. M. Right ovarian ligament. O. Left ovary. O'. Right ovary. P. Fimbriated aperture of left oviduct. P'. Aperture of right oviduct. R. Round ligament of left side. R'. Round ligament of right side. T. Left oviduct. T' Right oviduct, pulled down to show ovary. U. Anterior face of body of uterus. V. Vagina. V'. Posterior column of vagina.

the uterus, since there is no proper connective-tissue layer, and consequently no sharp boundary between the lining membrane and the deeper muscular layers.

The utricular glands are very numerous; they are placed vertically to the inner surface of the uterus, and are either straight or more or less convoluted; their blind ends are usually slightly dilated; they secrete a transparent, glutinous, alkaline fluid.

During both menstruation and pregnancy the lining epithelium and the musculo-glandular layer undergo very rapid and very extensive changes, which will be more fully described further on. These consist chiefly in a very great increase in thickness of the whole layer, and in a great increase in complexity of the glands, together with hyperplasia and hypertrophy of the cellular elements, and the formation of a thick layer of rounded cells on the inner surface of the epithelium.

The greater part of the thickness of the wall of the body of the uterus consists of non-striated muscular fibres. In the unimpregnated uterus it is very difficult, or even impossible, to make out any definite arrangement of these fibres in layers; but in the pregnant uterus the muscle-fibres not only undergo great increase in number and in the size of the individual fibre cells, but also exhibit a more or less definite arrangement. The uterus as modified by gestation will be described further on.

Ligaments of the Uterus.—The peritoneum (Fig. 7) covers and is closely connected with the anterior and posterior surfaces of the uterus, but at each side is produced laterally as a double fold—*the broad ligament* (Fig. 10), which is connected with the side of the pelvic cavity. The peritoneum forms, in fact, a double fold, stretching across the pelvic cavity between the bladder and rectum, and having between its two layers the uterus in the median line, and on either side (Fig. 10) the Fallopian tube, the ovary, and, besides bloodvessels and nerves, muscular fibres and certain other structures which have now to be noticed.

The most important of these are the *round ligaments* (Fig. 10, R), a pair of flattened cords, corresponding to the spermatic cords in the male, which arise from the upper angles of the uterus just in front of the openings of the Fallopian tubes, and run downwards and forwards at the sides of the bladder to the internal inguinal rings, which they enter. Passing down the inguinal canals they reach the forepart of the pubic symphysis, where they end by becoming united with the tough connective tissue of the mons veneris. The tubular investment of peritoneum ensheathing each round ligament in the inguinal canal is called the *canal of Nuck*, and usually becomes obliterated in the adult, though it may persist and give rise to hernia of the ovary. The round ligament consists of connective tissue and bloodvessels, and also contains muscular fibres prolonged from the outer muscular layer of the uterus.

Other structures lying between the two layers of the broad ligament are the *ligaments of the ovaries*, a pair of dense fibrous cords (Fig. 10, M) connecting the ovaries with the upper angles of the uterus, which they join just behind and below the Fallopian tubes. There is also a sheet-like expansion of muscular fibres spread out in the broad ligament, continuous with the external muscular investment of the uterus.

A pair of small folds of peritoneum, the *vesico-uterine ligaments*, run from the side of the uterus to the bladder, and bound laterally the pouch between bladder and uterus (Fig. 7); and a similar pair of folds, though somewhat more conspicuous, the *recto-uterine ligaments*, running from the back of the uterus to the rectum, form the lateral boundaries of the space of Douglas.

These so-called ligaments of the uterus hardly deserve their name, for they have very little influence in keeping the uterus in its place, and allow it to move freely to a considerable extent and in any direction.

Bloodvessels of the Uterus.—The arteries supplying the uterus are four in number—viz., the two uterine and the two ovarian. The uterine arteries are branches of the internal iliacs, which, after passing down the neck of the uterus, ascend between the layers of the broad ligament along the sides of the uterus, supplying it with branches, and anastomosing near

their terminations with branches from the ovarian arteries. These latter, corresponding to spermatic arteries of the male, arise from the aorta a little way below the renal arteries, and on reaching the margin of the pelvis turn inwards between the layers of the broad ligament and, after sending branches to the ovaries and Fallopian tubes, join, as stated above, the uterine arteries near their termination.

The arteries are remarkable for their extremely tortuous course and their frequent anastomoses. The former feature has been supposed to be a provision to prevent stretching of the arteries during the great distention of the uterus in pregnancy; but inasmuch as the arteries become *more* tortuous during pregnancy, this can hardly be the true cause. The arteries of the two sides anastomose freely, and the smaller branches form a fine network surrounding the utricular glands.

The veins correspond to the arteries; they are chiefly characterized by having no valves and by their large size, forming irregular venous plexuses. In the gravid uterus, and especially in the placenta, the veins undergo very marked and special dilatations, as will be noticed more fully later on. Owing to their large size they are peculiarly liable to stagnation of the circulation, and hence to the formation of phleboliths. The veins are most abundant in the middle or intermediate muscular layer.

The nerves of the uterus are derived from the hypogastric and spermatic plexuses, and, according to some writers, from the third and fourth sacral nerves, though this is denied by Dr. Snow-Beck and others. They reach the uterus by the broad ligament, and are said to be more abundant in the cervix than in the body of the uterus. During pregnancy the individual nerve-fibres, like the muscle-fibres, increase greatly in size.

The lymphatics, like all the other tissues of the uterus, undergo great increase in size during pregnancy, when they form large plexuses immediately beneath the peritoneum. Their distribution in the deeper parts of the uterus is only very imperfectly known.

Besides the changes in size and structure that occur during menstruation and pregnancy, the uterus also varies at different periods of life. In the infant the cervix is larger than the body, and the cavity is very narrow. At the time of puberty the uterus has acquired its definite pyriform shape, but the cavity has undergone but little alteration in shape; the arbor vitæ is very distinct. In women who have not borne children the shape of the cavity undergoes but little change, but after pregnancy it acquires and retains the triangular shape shown in Fig. 9. The os externum also, after pregnancy, remains wider than before, and its margins are often puckered.

After the close of the childbearing period of life the uterus gradually shrinks; its coats become firmer and less vascular; and the cervix and body become less sharply marked off from one another.

The principal *congenital malformations* to which the uterus is liable consist in a more or less complete division of its cavity into two halves by a median septum, which may even extend the whole length of the vagina. These conditions find their explanation in the fact that the vagina and uterus are formed by the fusion of two originally distinct and independent tubes, the upper parts of which remain separate from one another throughout life as the Fallopian tubes; and the various abnormalities that occur are chiefly due to the fusion being, in exceptional cases, only incompletely effected, the two tubes remaining distinct from one another in places where they normally fuse together to form one. According to the varying extent to which the two tubes remain distinct, we may have a single uterus divided internally by a median septum; or else two uteri with a single vagina; or finally, in extreme cases, two uteri and two vaginæ.

The Fallopian Tubes or Oviducts.—These, as we have just seen, are the upper and persistently separate parts of the two tubes by the fusion of whose lower ends the uterus and vagina are formed. Each Fallopian tube forms a thickened cord about 8 to 10 cm. in length, running along the upper or free border of the broad ligament, and lying between the two layers of peritoneum forming that ligament (Fig. 11). These cords are narrow at their

FIG. 11.

THE OVARY AND FALLOPIAN TUBE; THE LATTER BEING OPENED LONGITUDINALLY ALONG ITS WHOLE LENGTH. (From TARNIER, after SAPPEY.)

1. Ovary. 2. Part of uterus. 3. Ovarian ligament. 4. Fallopian tube. 5. Fimbriated aperture of Fallopian tube. 6. Grooved fimbria attached to ovary. 7. Longitudinal folds of lining membrane of Fallopian tube. 8. Opening of Fallopian tube into uterus.

inner ends, where they are attached to the upper angles of the uterus; but as they pass outwards increase in size, and, pursuing a somewhat undulating course, bend backwards and outwards, and end in expanded trumpet-shaped mouths, which are turned downwards towards the ovaries, and whose margins are produced into a number of fimbriated processes, in connection with which hydatid dilatations frequently occur. One of the fimbriæ, rather larger than the rest, is attached to the outer end of the corresponding ovary. A slight groove running along this process leads to the *ostium abdominale*, or abdominal opening of the Fallopian tube, through which the ova, after the discharge from the surface of the ovary, enter the tube.

The cavity of the Fallopian tube beyond the external opening at first dilates somewhat, but towards the uterus contracts very considerably, its opening into the uterus—the *ostium uterinum*—being so small as only to admit the passage of a small bristle.

The Fallopian tube is lined throughout its whole length by a columnar ciliated epithelium, the cilia working towards the uterus, and probably being the principal means by which the ova are caused to pass along the tube to the uterine cavity. The lining membrane, which at the external opening of the tube is continuous with the peritoneum of the body-cavity and at the internal opening with the uterine mucous membrane, is raised into a number of longitudinal ridges (Fig. 11, 7), which are best developed in the wider outer half of the tube, and which give this portion a stellate appearance in transverse section. Contrary to what was formerly asserted, there appear to be no glands in the Fallopian tubes.

Outside the mucous membrane is the muscular tissue, arranged as an inner circular and an outer weaker longitudinal layer, continuous respectively with the internal and external muscular layers of the uterus. Outside the mus-

cular layer is a very vascular connective-tissue layer; and outside this, the peritoneum of the broad ligament.

The Ovaries.—The ovaries (Fig. 10) are a couple of flattened oval bodies about 4 cm. in length, 2 cm. wide, and 1.25 cm. thick. They are attached along their anterior borders to the back of the broad ligament, which forms a special peritoneal investment round them. Along the line of attachment or hilum, bloodvessels and nerves enter from the broad ligament. The inner end of each ovary is connected with the upper angle of the uterus by the ovarian ligament; the outer end with the mouth of the Fallopian tube by the elongated and grooved fimbria referred to above.

Each ovum consists of a connective-tissue stroma containing bloodvessels, nerves, and a few muscular fibres, and invested by an epithelial layer formed by the peritoneum. In the epithelial layer and in the stroma are ova in various stages of development, the structure and mode of formation of which have already been described in the previous chapter.

Parovarium, or Organ of Rosenmüller.—Attached to the upper and outer corner of each ovary, and lying between the layers of the broad ligament, is the *parovarium* (Fig. 12), a group of convoluted tubules, converging

Fig. 12.

Adult Ovary, Parovarium, and Fallopian Tube.
(From Quain's *Anatomy*.)

a, *a*. Parovarium, formed from upper part of Wolffian body. *b*. Remains of uppermost tubes, sometimes forming hydatids. *c*. Middle set of tubes. *d*. Some lower atrophied tubes. *e*. Atrophied remains of Wolffian duct. *f*. The terminal bulb or hydatid. *h*. Fallopian tube. *i*. Hydatid attached to end of Fallopian tube. *l*. Ovary.

below, and connected together above by a longitudinal duct, which ends on the outer side of the parovarium as a slightly dilated bulb, and which on the inner side, *c*, can be traced for a short distance towards the uterus. These structures will be referred to again when dealing with the development of the reproductive organs: here it will suffice to say that they have no functional relation to the female generative organs, and that the parovarium corresponds to the epididymis in the male, and its duct to the vas deferens.

The ovaries and Fallopian tubes are supplied by the ovarian arteries, and also indirectly by the uterine arteries, through their anastomoses with the ovarian arteries already described. In exceptional cases these anastomotic branches may be so large that the main supply of the ovaries is through the uterine arteries.

The veins correspond to the arteries, and form in the broad ligament near to the ovary a plexus—the pampiniform or ovarian plexus—which communicates with the uterine venous plexus.

THE MENSTRUAL PROCESS.

Definition.—Menstruation is commonly taken to consist in the periodical discharge of blood from the uterus. This, the most conspicuous objective phenomenon, is, however, only one act in a complicated process, of which the genital system is the focus, but upon which the entire organism is at work.

The menstrual flux is also known by the appellation *catamenia* (κατά, at the time, μήν, month) expressive of the periodicity of the flow. Women have various popular names for it, mostly metaphorical and conventional.

The phenomena constituting and attending menstruation are *local*—that is, especially affecting the ovario-uterine system;—and *constitutional or remote.*

The first in order are those observed in the ovary. In this organ resides the *primum mobile* of the process.

The Changes in the Ovary consist in the maturation of an ovum, the bursting of the Graafian follicle and its subsequent retrogression. This involves active hyperæmia of the organ and of the entire vascular system of the pelvis. Richet has shown that the venous system in the broad ligaments is enormously distended, so as to form bumps or swellings appreciable on vaginal touch. These may form a soft and fluctuating tumor, which disappears in a few days after the menstrual flux. We have known this venous swelling mistaken for enlarged ovary. The ovary itself is greatly enlarged; and the *Fallopian tubes*, especially their fimbriæ, become intensely gorged and swollen.

Cases in which a periodical flux not distinguishable from menstruation has been observed after removal of both ovaries are indeed not wanting. They may be explained to some extent as follows: 1. In some cases a remnant of ovarian structure has escaped amputation (Waldeyer, Spencer Wells). 2. The habit of menstrual flux, once acquired under the dominion of the ovaries, may be kept up after the removal of the organs. The system, accustomed to periodical accumulations of blood and its evacuation, readily pursues the old practice. The vascular tension so induced must be relieved, and the normal point of discharge is the uterine mucous membrane. Often, however, especially at and after the climacteric, it is some other portion of the mucous tract; and it is certain that beyond the ovaries there is a law of periodicity universal in its operation.

Before the first menstrual flow it is exceptional to find cicatrices on the surface of the ovary. These cicatrices are the marks of the escape of ova. A smooth ovary implies that menstruation and pregnancy have not taken place.

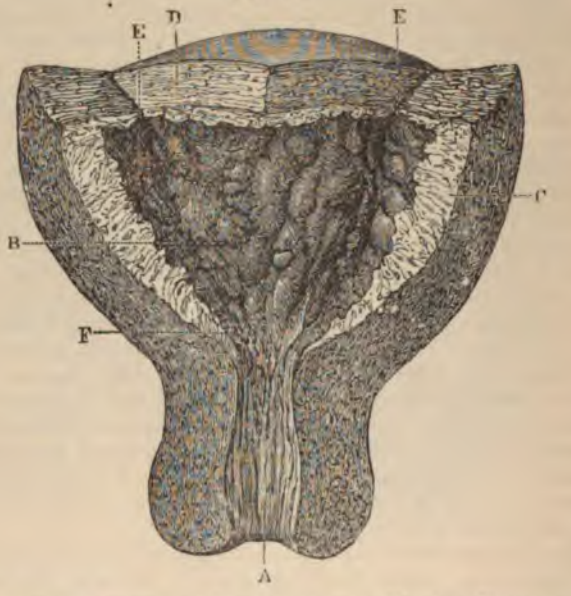
Changes in the Uterine Mucous Membrane Accompanying Menstruation.—These changes consist in congestion and tumefaction of the inner wall of the uterus, affecting both the musculo-glandular layer and the lining epithelial membrane. The musculo-glandular layer swells up considerably, becoming softer and more vascular than before while the utricular glands increase greatly in length and become convoluted. The whole layer increases from about 1.5 mm. to 3 mm. in thickness, while the glands increase in diameter from 0.08 to 0.12 mm.

The epithelium lining the uterus, which we have seen is continuous with that lining the utricular glands, undergoes still greater changes; becoming converted into what is known as the catamenial or menstrual decidua, a thick cellular layer traversed by irregular channels leading from the utricular glands to the cavity of the uterus, and also containing an abundant capillary network.

It was formerly considered that the catamenial decidua was due to swell-

ing of the musculo-glandular layer as well as the uterine epithelium, and that the channels traversing it were the modified utricular glands. Ercolani, however, who has recently devoted much attention to the study of the decidua both of menstruation and of pregnancy, has shown that the decidua is due almost entirely to the rapid proliferation of a layer of cells derived from and replacing the uterine epithelium. He has further shown that the channels are due in the first instance to the fact that as there is no epithelium over the mouths of the glands, this new formation cannot occur at these places, and that they are afterwards kept open by the continual passage of the secreted fluid into the uterus. The development of the decidua is so great and rapid that it surpasses the ordinary capacity of the cavity of the uterus. It is therefore thrown into lobes or folds, somewhat resembling the cerebral convolutions. (See Fig. 13.)

FIG. 13.



UTERUS LAID OPEN TO SHOW THE HYPERTROPHY OF THE MUCOSA IN MENSTRUATION. (After TARNIER.)

A. Mucosa of the cervix. B. Mucosa of the body, very turgid C. Thickness of the section of the mucosa. D. Uterine tissue proper. E, F. Mucosa diminishing in thickness at os internum and openings of Fallopian tubes.

Having attained a certain development, the menstrual decidua stops, and then begins to retrograde, its cells undergoing fatty degeneration. It is at this period that the menstrual hemorrhage occurs, and it is very probable that the hemorrhage is directly connected with the process of fatty degeneration, although the exact nature of the connection has not yet been ascertained.

After the hemorrhage the disintegration of the decidua continues, and finally the whole decidua is cast out in fragments, or more rarely as one single piece. In the latter case, observed in dysmenorrhœa membranacea, the decidua will be a cast of the inner surface of the uterus. The uterine epithelium is quickly replaced, apparently growing over the surface from the necks of the utricular glands, and is usually completely reformed by the ninth or tenth day after

menstruation. By the eighteenth day a new decidua has commenced to form, and the whole process is then repeated over again.

Connection between Menstruation and Ovulation.—That there is some connection between these two processes is obvious from what has been said above. They are both periodically recurring processes, and the periods of the two correspond closely; they both commence about the time of puberty, and last throughout the whole childbearing period of life. When, however, we try to investigate more closely the nature of this connection, we meet with difficulties which have not yet been satisfactorily surmounted.

The principal facts we have to guide us are the following:

It has been ascertained by direct observation that one or both ovaries swell and become tender every three or four weeks. According to Oldham, they enlarge for about four days, remain stationary for about three days, and then gradually subside. It has also been ascertained that the enlargement commences as a rule shortly before the menstrual period, that it attains its maximum about the time of this period, and subsides after the menstrual hemorrhage (Robert Barnes and Fancourt Barnes).[1]

As the ovary is known to become congested just before the rupture of a Graafian follicle and the discharge of an ovum, it would appear a fair inference that this discharge occurs about the same time as, or shortly before, the menstrual flux—*i. e.*, that ovulation and menstruation occur simultaneously. However, although this may be, and probably is, the rule, yet it is far from being an invariable one. Thus Kölliker, on examining the ovaries of seven women who had died directly after menstruating, found that in two of the cases there was no fresh corpus luteum in either ovary—*i. e.*, that no ovum had been discharged at the time of menstruation; and Coste has cited similar cases.

If, on the other hand, we consider the process of menstruation more carefully, we are at once struck with the fact that the menstrual flux is not the perfecting of a process already commenced, but marks the commencement of retrograde development, the undoing of a process which has already reached and passed its full completion. The formative or constructive process, so far as the uterus is concerned, consists in the gradual building up of the decidua; and the menstrual flow marks the commencement of the destructive process by which that decidua is broken up and discharged.

Hence, if we wish to determine the nature of the bond between the periodical discharge of the ova and the periodical changes occurring in the lining membrane of the uterus, it is clear that we must consider, not so much the menstrual flux, the destructive process, as the constructive processes involved in the formation of the decidua.

There is now hardly any doubt that the formation of the decidua is to be regarded as a preparation of the uterus for the reception of an ovum; and since menstruation usually ceases as soon as a developing ovum reaches the uterus, it is highly probable that the menstrual flow—*i. e.*, the breaking up of the decidua—is simply due to the failure of an ovum to arrive.

We may, therefore, view the uterus as continually getting itself ready, by the development of a decidua, for the reception of an ovum; if no ovum arrives, the decidua after a time breaks up and is discharged, accompanied by a certain amount of blood, as the menstrual flux; if, however, a developing ovum enters the uterus, the decidua is not broken up, but persists, and menstruation does not occur again until after the birth of the child to which that ovum gives rise.

[1] See Robert Barnes's Memoir on Hernia of the Ovary, Amer. Journ. of Obstetrics, Jan. 1882.

We have seen above that the discharge of the ovum from the ovary probably occurs, as a rule, at or about the same time as the menstrual flow. Now, in order to reach the uterus the ovum has still to pass along the whole length of the Fallopian tube, and we shall see in a future chapter that this passage probably takes at least eight days to be completed. From this it follows that the decidua with which the ovum will ultimately come into relation is not that which is broken up and discharged at the time the ovum was set free from its Graafian follicle, but the next succeeding one; or, in other words, that the decidua which is discharged, as the menstrual flow, simultaneously with the setting free of an ovum by rupture of a Graafian follicle, is not the decidua belonging, as it were, to that ovum, but the decidua belonging to the previously discharged ovum, which decidua, after waiting in vain for the arrival of the ovum, has undergone disintegration, and is being got rid of, to allow the formation of a new one.

If this view is correct, it follows that there is no necessary connection between ovulation and the occurrence of the menstrual flow, a point which explains the cases quoted by Kölliker, Coste, and others, in which there was no discharge of ova at the time of menstruation. If, on the other hand, we seek to determine why the two processes usually occur at or about the same time, the answer may perhaps be found in the consideration that there is at the time of ovulation very considerable congestion of the ovaries and Fallopian tubes; and this, owing to the close connection of the ovarian and uterine arteries, must almost necessarily cause congestion of the uterus; and this sudden determination of blood to the very thin-walled vessels of the decidua is not improbably the primary cause of the menstrual hemorrhage.

Periodicity of Menstruation and Ovulation.—Why the ova should come to maturity and be discharged at tolerably uniform intervals is by no means clear. Among many animals a condition of sexual excitability with congestion of the external genitalia, known as the *rut*, occurs at a certain definite time of the year for each species, the time being such that if copulation occur during the rutting season, parturition (*i. e.*, the birth of the young) will occur at a season when food is abundant. Hensen has shown that if copulation be hindered during the rutting season, the excitability subsides in a few days, but is repeated at intervals of fourteen days in the case of the sheep, fifteen to eighteen in the sow, and four weeks in cows and mares; and this artificially induced condition, though it does not throw much light on the origin of the processes as seen in women, yet bears a singularly close resemblance to these latter.

Source of the Menstrual Blood.—In the living and dead it has been seen oozing from the inner surface of the body of the uterus; in the dead from the inner surface of the Fallopian tube (Letheby; Robert Barnes). In normal conditions no blood escapes on the surface of the canal of the cervix or from the vaginal portion. But in cases of morbid congestion, more especially if the epithelial layer is defective, blood may escape from this surface.

An excellent observation made by George Harley[1] is so precise as illustrating this and other points that it is transcribed in detail: "A married woman, æt. 23, drowned herself when menstruation was impending. The uterus was congested and enlarged to about one-half more than its usual size. On section the uterine tissue was rosy, and the open mouths of its bloodvessels were distinctly visible. The vagina was somewhat congested externally, but of the normal color internally. The mouth of the womb was filled with a white tenacious mucus, while the mucous membrane of the interior was hypertrophied throughout its whole extent, of a pink color,

[1] Pathological Trans., vol. xii.

which gradually increased in depth towards the fundus, at which it attained a dark livid color, and was covered with a quantity of blood. The blood was in greatest quantity at the mouths of the Fallopian tubes, but neither the congested nor hemorrhagic state of the mucous membrane extended beyond the openings of the tubes. Their interior was quite white and clean at the uterine extremity, but highly congested and filled with a milky fluid towards the fimbriated end. This mucous secretion was loaded with ciliated and other epithelium. The ovaries were enlarged, especially the left one, which contained a Graafian vesicle 0.75 mm. in diameter, ready to burst, and which actually burst whilst being handled. The vesicle contained a clear straw-colored serum, with a few flakes of the membrana granulosa floating in it. On the interior of the vesicle were numerous vessels, which gave to it a highly congested appearance."

Characters of the Menstrual Fluid.—It is essentially an eruption of blood. It is usually of viscous consistence, especially at the outset and decline. Mucus is mingled in various proportion. Indeed, the uterine glands frequently pour out a quantity of mucus before the blood-element appears, and mucous discharge is often continued for some days after the blood has disappeared. This mucus is alleged to have at times irritating properties, enough to distress the subject, and to cause blenorrhœa in the man. At the beginning the fluid is lightly tinged; at the middle it is deep red, almost pure blood; at the end it becomes paler. In chlorotic women the fluid is pale or greenish, owing to the scarcity of blood-globules; the "menstruatio alba" of old authors. The fluid has a *peculiar odor*, varying in different subjects. It is attributed by Virchow to fatty acids. To this odor various evil properties are vulgarly ascribed—not, perhaps, absolutely without reason. Certain it is that in some cases of dysmenorrhœa from obstruction there is absorption from the uterus; the breath and skin, serving as emunctories, reveal the presence of the offensive material in the blood.

Microscopical and Chemical Characters of Menstrual Fluid.—Blood-globules, white globules, and pavement epithelial cells, more or less granular, float in a serous fluid mixed with the secretions of the uterus and vagina.

Under ordinary circumstances menstrual blood does not coagulate. Whitehead explained this by showing that the vaginal mucus has an acid reaction, and that contact of the blood with this acid prevented its coagulation. Donné says that menstrual blood is acid, containing phosphoric and lactic acids. Mandl, however, showed that the smallest quantity of mucus or pus stopped blood from coagulating. Now, the menstrual fluid is blood mixed with mucus. This accounts for the fluidity. The flux is seen to be fluid as it emerges from the os externum uteri—that is, before it encounters the vaginal mucus; and in cases of retention of menstrual fluid the treacly consistence is well known. If the quantity of blood be in excess of the mucus, coagula may form *in utero*. This is observed in menorrhagia.

The quantity lost varies much. In health it may be estimated at 4 to 6 ounces; but this may be greatly exceeded under all the conditions of health. But it may be taken as a general fact that, if the quantity is not only excessive in amount but discharged rapidly, presenting clots, and depressing the vital powers, there is disease, local or general, or some other disturbing force.

The duration of the flow has some relation to the quantity. A typical menstruation lasts three, four, or five days. In some women it lasts a week. If protracted beyond this a morbid factor must be sought. The passing away should be gradual. If suddenly stopped, some accident, as cold, emotion, or disease, may be suspected.

The age at which menstruation first appears is usually that at which *puberty* is attained. This epoch is marked by the entrance of the ovary into active function. The universal law of periodicity now acts upon conditions prepared to respond. The determining conditions are—1. The energy of the sexual sense; 2. Latitude and mean temperature of the habitation; Education, occupation, and diet; 4. Race.

1. Influence of Sexual Energy.—In some individuals the tendency to early sexual development is strongly marked. The ovaries mature and discharge ova very early; the ovaries are large; the system generally exhibits evidence of precocity; hair grows early; sexual proclivities are manifested. Susewind saw a child, 27 months old, who had menstruated from the age of 12 months; she exhibited the molimen hemorrhagicum; her breasts and mons veneris were developed as in girls of 14 or 15. D'Outrepont and Carus relate analogous cases. Le Beau and Comarmond relate others. The subsequent history of these children has not been told. The following, related by Mr. Dodd ("Lancet," 1881), is therefore of special interest. Its authenticity is placed beyond dispute. On August 8, 1871, Mr. Dodd delivered F. M. of a female child. This child began to menstruate at 12 months, not very regularly at first, but varying from four to six weeks' intervals. The last two years (1878–9, 1880) the menstruation was every three weeks. The last appearance was on June 22, 1880, when she became pregnant. Mr. Dodd attended her in her labor on March 17, 1881. The child weighed 7 lbs. It died some time after in convulsions. The labor was not difficult. The hirsute growth on pubes and in axillæ is profuse; the breasts a week after labor were large and gorged with milk. This child was thus pregnant before she was 9 years old. The duration of her gestation may be estimated at 269 days.

Other illustrative cases are related (see "The Clinical History of the Diseases of Women," by Robert Barnes, 2d ed., 1878). In several cases of premature menstruation exhaustion and death occurred (Clifford Allbutt, "Med.-Chir. Trans.," 1866). But this is not the rule. Kussmaul says precocious menstruation is sometimes the result of disease, especially of new growths in the ovary.

2. Influence of Latitude and Longitude.—Joulin divides the peoples subjected to his statistical analysis into three zones. The temperate zone, situated between lat. 33° and 54° north; the second, belonging to hot climates, between 33° and the equator; the third corresponds to the cold regions, and extends from lat. 54° to the pole. Menstruation sets in in the temperate latitudes towards the 15th year; in the hot regions about the 12th year; and in the cold about the 15th or 16th; but great variations occur in each region, some of which are explained by the other influences specified.

Influence of Temperature.—Generally speaking, heat promotes menstruation, cold checks it. Thus we know women who menstruate regularly, perhaps profusely, in India, and scarcely see anything in England. Others we know who in England menstruate only in the summer.

3. Influence of Education, Occupation, and Diet.—The easier classes, who live luxuriously, generally menstruate early and freely, whilst those who live hard laborious lives menstruate later. Girls coming from the country to the great cities to work in sedentary occupations, hot rooms, and under new excitements, often menstruate sooner. (Stoltz, Brierre de Boismont, Leudet, Bernard, Faye, Mayer.)

4. The Influence of Race.—Certain races preserve the menstrual type proper to them in the country of their origin, even when transplanted.

Jewesses, whatever their habitat, menstruate generally somewhat earlier than girls of Saxon origin.

PERIODICITY.—The typical periodicity is every twenty-eight days. In many women the return is exact. In some, however, the interval from the commencement of one menstruation to the return of the next is less; but it rarely exceeds thirty days in health. The relation of menstrual periodicity to gestation and labor will be discussed hereafter. (See "Gestation.") The periodicity observed in menstruation and gestation is only one instance of the great general law of periodicity which governs the tides, animal and vegetable life. (Darwin, Wiltshire.)

THE CESSATION OF THE CATAMENIA.—The cessation of the function marks the *climacteric epoch*. This is also called the *menopause* (*μήν*, mouth; *παῦσις*, arrest). The age at which this occurs is even more difficult to fix than is that of the beginning. It rarely occurs before the age of 45. But many women present a periodical flow, which they persistently designate as menstruation, until the age of 50 or even more. In some of these it cannot be doubted that the menstruation is real and normal. In others, mixed up with the habitual flow, there is as certainly a morbid factor at work. In some, again, menstruation is arrested at from 35 to 40. J. Y. Simpson explained these by the theory of hyperinvolution. Intercurrent conditions of the ovaries and uterus may arrest ovulation. The ordinary involution after labor seems to pass the physiological bounds, and to proceed to positive atrophy, ushering in a premature senility. We can attest the fact that women who have borne a child at 36 or 37 have never menstruated or conceived again.

Négrier explains premature climacteric by original feeble ovarian development. Languid genital capacity is exhausted long before the normal period. In other cases disease involving disintegration of the ovaries, or disease of distant organs, may be the cause.

The argument drawn in favor of protracted menstruation from cases of pregnancy at advanced ages will be discussed under "Gestation."

It is a popular belief that women who begin to menstruate early will cease early, and *vice versâ*. This is not always true. It would even appear that in some cases menstruation begins early and is continued late under the influence of unusual ovarian energy.

The history of *the disorders of menstruation* properly belongs to gynæcology. It is fairly discussed in Robert Barnes's "Clinical History of the Diseases of Women."

An important point may be considered here: *What is the significance of the arrest of menstruation in women during the period of reproductive capacity?* Is it due to disease? This we cannot here discuss, but the question should always be present to the clinician. Is it due to gestation? This will be discussed under "The Signs of Gestation." Menstruation is also arrested, commonly, during lactation.

Constitutional Phenomena attending Menstruation.

Menstruation is immediately preceded by *increased nervous tension and mobility*, manifested in exalted psychical, emotional, and reflex action.

Closely following upon the increase of nervous tension is *increased vascular tension*, manifested by turgescence of the capillary and venous system. The vascular tension falls quickly when the menstrual blood-flow sets in.

Increase of nervous and vascular tension, implying a more active process of nutrition, entails a rise of temperature. This rise, observed to the extent

of 0.5° F., under strictly physiological conditions, may rise to 1° F., or more, if any perimetric inflammatory action is present.

Increased nutrition-process entails increased excretion of urea.

The Nervous Phenomena.—The process of menstruation, like all exudations of the genital system, *increases reflex sensibility.* Thus are explained certain nervous phenomena, as shivering followed by sense of heat, yawning, heaviness of sleep, stiffness in the neck, loss of appetite, or boulimia, enteralgia, intestinal meteorism, palpitation, hoarseness, hiccup, vomiting, cramp, frequent desire to micturate, diarrhœa. These symptoms, however, more commonly in our experience are the consequences of difficult or impeded menstruation.

The Vascular System Undergoes Exalted Tension.—The quantity of blood is increased; the heart is stimulated to increased activity; this is proved by sphygmographic observations (Marey, Fancourt Barnes, Macdonald, Stephenson); the pulse is more frequent; the capillary or peripheral vessels are congested; the skin is more vascular; nævi are deeper colored; hemorrhoids swell, perhaps bleed; sometimes eruptions of blood escape on the surface, but more frequently from a mucous membrane, as the conjunctiva, the nose, the lungs, the stomach or other part of the alimentary canal; or from the kidneys or bladder. These blood-effusions may attend the menstrual discharge, and are then called *supplementary menstruation;* or they may occur instead of the menstrual discharge, when they are called *vicarious* or *ectopic* menstruation (Robert Barnes). There cannot be a doubt that these ectopic bleedings are sometimes conservative in their operation, saving the subject from internal effusions in the head, lungs, or peritoneum.

The Entire Glandular System of the Body Undergoes Stimulation.—The pulmonary mucous membrane, the glands of the alimentary canal, of the skin, all exhale or secrete more actively. But the breasts exhibit the clearest phenomena. They swell, become tender to touch, even painful, and, rarely, a little serous oozing may flow from the nipples.

Pigmentation is also excited. This is mostly seen under the eyes, on the nipples, and on the genitals.

The relation of temperature, heart-beat, and urea to menstruation is thus expressed by Professor Stephenson, of Aberdeen:[1] "Menstrual life is associated with a well-marked trace of vital energy, which manifests itself in the temperature of the body, in the daily amount of excretion of urea, and, to a slighter extent, in the pulse-rate. The temperature is the most uniform and gradual in its rise and fall. In the urea-curve the transition to elevation takes place more quickly, even suddenly."

What is the Physiological Purpose of Menstruation?—The ultimate purpose is the preparation for conception and gestation. A comprehensive review of the phenomena of ovulation and menstruation in their sequence and correlation reveals the most striking points of similitude with gestation. We see in the formation of the decidua the preparation of a nidus in the uterus; in the reception of the extruded ovum in the Fallopian tube and uterus, the progress to meet fertilization by contact with the male element. Up to this point menstruation is the simulacrum of gestation—a mimic pregnancy. We see again in the breaking up of the ovum, the casting off of the decidua; the hemorrhagic discharge and the subsidence of nervous and vascular tension, a repetition of the most striking phenomena of labor. There is a missed pregnancy, a simulated labor (Robert Barnes).

If it be objected that it seems a contravention of the universal law, "Nil natura frustra facit," that a woman should go on spending thirty years of

[1] On the Menstrual Wave, Amer. Journ. of Obstet., 1882.

her life in monthly preparations for pregnancy when she can rarely bring forth more than twelve children, it will be enough to point out that a similar and infinitely greater waste of reproductive energy prevails throughout the entire animal and vegetable kingdoms. But is this expenditure really a waste? Future inquiry will almost certainly prove that this expenditure of excess of reproductive energy is a factor in maintaining the balance of vegetable and animal life.

The immediate purpose of menstruation is to discharge the superfluous material and energy prepared for the missed pregnancy. In the later stage we may have a similarity in the puerpery. The superfluous blood is thrown off, absorption is more active. Andral and Gavarret showed that the quantity of carbonic acid exhaled by the lungs rises until the age of 30 in men, but only until puberty in women; moreover, that in women it falls off as soon as menstruation is established, to increase again after the menopause. If for any cause the menstrual flow is arrested for several months, as by pregnancy or lactation, the quantity of carbonic acid is increased, as after the menopause. Lastly, old age, as in men, entails the diminution of the phenomena of combustion.

CHAPTER III.

IMPREGNATION AND CONCEPTION—GENERAL ACCOUNT OF MAMMALIAN DEVELOPMENT.

In the ovum itself, about the time of attaining maturity, certain changes of great importance occur. Owing to the extreme difficulty of obtaining material at the proper time and in suitable condition for microscopic investigation, these changes have not yet been seen to occur in the human ovum; but inasmuch as they are now known to take place in nearly all the groups of invertebrate animals, and have also been described, though less completely, in fish, amphibians, and mammals, there is hardly any room for doubting that they occur in man also.

These changes, which appear to take place in mammals about the time of rupture of the Graafian follicle and escape of the ovum, are best known to us through the researches of Ed. van Beneden on the rabbit's ovum. The ovum first contracts slightly, so that it no longer completely fills the *zona pellucida* (*vide* Fig. 14). The germinal vesicle, which had previously occupied a central or only slightly eccentric position, now travels to the surface of the ovum; the delicate membrane enclosing the germinal vesicle disappears, and the contents of the membrane—*i. e.*, the nuclear reticulum and the

FIG. 14.

RABBIT'S OVUM, TAKEN FROM THE FALLOPIAN TUBE TWELVE HOURS AFTER IMPREGNATION.
(From QUAIN'S *Anatomy*, after BISCHOFF.)

Numerous spermatozoa are seen embedded in the zona. In the space between the zona and the yolk, caused by the shrinking of the latter consequent on impregnation, are seen two polar bodies.

germinal spot—become modified so as to form what is called the nuclear body, which is situated within the ovum, but close to its surface. A little later, part of this nuclear body is ejected from the egg, and forms two small "polar bodies" (Fig. 14) lying in the space between the *zona pellucida* and the ovum, formed by the shrinking of the latter, as already noticed.

Van Beneden held that the whole of the nuclear body was bodily extruded from the egg; but from the analogy of other animals it is in the highest degree probable that only a portion is extruded, and that the remainder stays within the egg, and, travelling towards its centre, forms what is called the *female pronucleus*.

The upshot of this process is, practically, that the germinal vesicle moves from the centre to the surface of the egg, and that, after undergoing certain changes, part of it is bodily extruded from the egg while the remainder

stays within it. The change is an exceedingly important one, because it appears that after the polar bodies are extruded the ovum loses all power of further development. We have seen above that the ovum is a single cell, which originally formed part of the germinal epithelium, and that the germinal vesicle and germinal spot bear the same relation to the whole ovum that the nucleus and nucleolus do to an ordinary epithelial cell. Now, in the ordinary process of multiplication of cells by division, the nuclei are known to play a very important part; when a cell is about to divide into two the nucleus divides first, so that we have a stage in which there is a single cell with two nuclei, and then, later on, the whole cell divides into two halves, each containing half of the original nucleus. From this it appears that the nucleus is the part of the cell specially concerned with the process of reproduction or multiplication, and the part in which that process is initiated.

The formation of the embryo from the ovum is, as we shall see immediately, essentially a process of cell multiplication by division, in which the nucleus of the ovum plays exactly the same part as the nucleus of an ordinary epithelial cell. An ovum with an entire germinal vesicle or nucleus must be supposed to have in itself the power of multiplication by fission, and so of producing an embryo, and, as we see in the case of many insects, such an ovum has actually this power; but after the extrusion of the polar bodies the ovum is left with an imperfect, an incomplete nucleus, and is *no longer capable of multiplication, unless the portion of the nucleus that has been extruded is replaced.*

The above considerations will enable us to obtain a clearer idea than would otherwise be possible of the nature and importance of the act of impregnation.

Impregnation and Conception.—By impregnation, fertilization, or conception, is meant the act by which it is determined that the ovum having reached the stage just described does not stop at it, but develops into an embryo; the two former words being generally applied to the process as it affects the ovum itself directly, while conception is employed in a more general sense to include the changes that occur in the maternal organs in consequence of the act of fertilization, as well as this act itself.

Fertilization is effected by contact of the male reproductive elements or *spermatozoa* with the female element—the ovum. The human spermatozoa are filamentous bodies about 0.06 mm. long; each consists of a flattened oval head, and a long slender tail tapering gradually towards its free end; during life they possess the power of moving rapidly by vibrating or lashing movements of the tail. During the act of copulation large numbers of spermatozoa floating in the viscid transparent seminal fluid are injected into the vagina; these pass into the uterus and along the Fallopian tubes until they encounter the ovum, their transportation being probably effected mainly, if not entirely, by their own inherent power of locomotion. Why the spermatozoa should thus work their way upwards has been much debated; but when we consider the enormous number of spermatozoa discharged into the vagina, and their active power of movement, it is almost inevitable that some of them should find their way up the uterus and into the Fallopian tubes. Ciliary action, to which the movement is sometimes ascribed, can hardly have anything to do with it, for the mucous membrane of the uterus is subject to such constantly recurring changes owing to menstruation, and in the Fallopian tubes themselves the cilia work the wrong way to be of any use.

Fertilization of Ovum.—On arriving at the ovum the spermatozoa bury themselves in the *zona pellucida*, and in Fig. 14 a number of them are shown in this position. One of them goes further; its head penetrates into the

ovum itself, and separates from the tail, which remains outside and ultimately disappears. The head, once inside the ovum, increases in size, assumes a radiate appearance, and is known as the *male pronucleus*. The male and female pronuclei—the latter, it will be remembered, being the portion of the original germinal vesicle which has remained in the ovum—now gradually approach one another, and ultimately fuse to form the definite nucleus of the fertilized egg.[1]

After the formation of this definite nucleus the ovum regains the power of multiplication by fission, which it had previously lost by the formation of the polar bodies; in other words, the act of impregnation consists in the replacement by the head of the spermatozoon of that portion of the original germinal vesicle, or nucleus of the ovum, which had at an earlier stage been extruded bodily from the ovum in the form of the polar bodies.

It has been stated that primitive ova occur in the male as well as the female embryo. In the female they become converted, as already explained, into the permanent ova; and in the male they give rise by a series of changes to the spermatozoa; so that from these primitive ova the essential reproductive elements of both sexes are derived; the main difference between them being, that while in the female each primitive ovum becomes a single permanent ovum, in the male each primitive ovum gives rise to a considerable number of spermatozoa.

We thus see that the male and female elements, the spermatozoa and ova, are fundamentally very similar to one another; and if we reflect further that the head of the spermatozoon is almost entirely made up of its nucleus, derived by repeated division from the nucleus of the primitive ovum, we shall see that in the fusion of female and male pronuclei we have really the fusion of a portion of the nucleus of a permanent ovum, which is itself derived from the nucleus of a primitive ovum, with the nucleus of a spermatozoon which is also derived by fission from and is therefore a part of a nucleus of a primitive ovum;—*i. e.*, that the fusion is between two parts of very similar morphological value.

If we inquire further as to the cause of this process of impregnation, the answer is probably to be found in the great advantage as to vigor of the progeny which is known to accrue to both animals and plants from cross-fertilization as contrasted with self-fertilization; it may even be, as suggested by Balfour, that the habit of forming polar bodies—*i. e.*, of providing that development cannot possibly occur without impregnation, has been acquired and perpetuated for the express purpose of insuring that cross-fertilization should be the invariable rule.

As to the number of spermatozoa necessary to insure fertilization, or normally taking part in it, our knowledge is very imperfect. From observations on the lower animals it would appear that a single spermatozoon is sufficient, but that more than one may be concerned in the act.

Another much disputed point is as to the locality at which impregnation is effected. It is naturally very difficult, from lack of evidence, to arrive at a definite conclusion, but from the analogy of other animals, and from such observations as we possess on the human species, it appears probable that the spermatozoa encounter the ovum and impregnate it as a rule in the upper third of the Fallopian tube.

Some writers have supposed that the ovum may be impregnated while still in the ovary, before rupture of the Graafian follicle has occurred, and this

[1] All the details of this process have not yet been seen in the mammalian ovum, but the analogy of lower animals leaves little room for doubt that the above description is correct in all essential points.

is possible, although the greater depth that the spermatozoa would have to penetrate in order to reach the ovum, and the great uncertainty of their coming in contact with the ovum at all, must render impregnation in this situation, if it occurs at all, very exceptional. The cases of supposed ovarian pregnancy which have been cited in support of this view are, as will be noticed in a future chapter, by no means satisfactorily made out.

VITALITY OF SPERMATOZOA.—It is clear that if impregnation occurs in the upper third of the Fallopian tube, a certain interval must elapse between copulation and fertilization, during which the spermatozoa have to work their way from the vagina into the uterus, and then along the Fallopian tube until they encounter the ova. Concerning the length of this interval we have no certain information; it is probably subject to considerable variation in different cases, for the varying condition of the lining membrane of the uterus cannot but influence materially the passage upwards of the spermatozoa. The superior limit of this interval is probably determined by the length of time during which the spermatozoa retain their vitality and fertilizing power, but here again we are dealing with points on which our knowledge is very imperfect.

The spermatozoa of many animals are known to retain their fertilizing power for very considerable periods. Thus in the case of domestic fowls the spermatozoa introduced into the oviduct of the hen retain their impregnating power for about eighteen days; in the bat the spermatozoa remain in the uterus and retain their power during the whole of the winter; and in the case of the queen bee the spermatozoa received from the drone, and stored up in the receptaculum seminis of the queen bee, have been known to retain their fertilizing power for as long as three years.

Concerning the human spermatozoa we know that, after reaching their full development, they may remain for months in the testes before being discharged without losing their fertilizing power; and when we remember for how long a time spermatozoa in animals are known to retain their power after introduction into the female organs, it is, at any rate, probable that the human spermatozoa remain alive and functionally active for some time after passing into the uterus and oviducts.

Exact observations and determinations are not yet forthcoming; indeed, we have no observations whatever on the spermatozoa in the human oviduct. Spermatozoa have often been collected from the vagina, or even from the cervix uteri, and have been known to preserve their mobility, and therefore presumably their fertilizing power as well, for five days, and in one case for seven and a half days after their introduction into the vagina.

We may therefore conclude that in all probability the human spermatozoa retain their vitality and functional power for at least a week after introduction into the uterus, while the analogy of lower animals renders it very possible that they may do so for a considerably longer period.

VITALITY OF OVUM.—Returning now to the ovum: if this be not impregnated it soon dies. The length of time during which the ovum retains its vitality and capability of impregnation is not known to us with any degree of certainty; indeed, no unfertilized human ovum has yet been seen outside the ovary. Some experiments of Bischoff on lower animals point to the conclusion that in them death of the unfertilized ovum occurs in the lower part of the Fallopian tube before reaching the uterus; and if we assume the same to occur in woman, and also, as is done by the best authorities, that the human ovum takes at least eight days to travel down the Fallopian tube, we arrive at the conclusion that the human ovum probably retains its power of fertilization for about a week after its discharge from the ovary.

Concerning both ova and spermatozoa these determinations are, however,

matters of mere speculation. All that we are justified in asserting with any certainty is that (1) the human spermatozoa undoubtedly may retain their vitality after entering the cervix uteri for at least a week, while the analogy of other animals renders it probable that this is by no means the superior limit; (2) that the human ova probably retain their vitality and power of being impregnated for some time after discharge from the ovary, but ultimately lose it, probably before reaching the uterus.

Intimately connected with these questions are certain other points of much interest and practical importance. Thus, inasmuch as impregnation consists merely in contact of the spermatozoa with the ova, it is clearly, so far as the woman is concerned, a perfectly involuntary act; and hence it becomes intelligible how impregnation, as is known to be the case, may be effected during a state of unconsciousness—either from deep sleep or from narcotic poisoning—*i. e.*, how a woman may become pregnant without having the slightest knowledge or suspicion of how or when she was rendered so.

A further point in dispute concerns the relation between the processes of impregnation on the one hand, and, on the other, ovulation and menstruation.

The discharge of ova from the ovary is a process which recurs periodically at intervals of about a month; these ova only retain their power of being impregnated for a certain time, which is probably less than the interval between the successive discharge of ova. Hence there must be certain periods during which there are ova ready to be fertilized, and certain times during which there are none—*i. e.*, impregnation can only be effected at certain recurring periods, and cannot occur in the intervals between these periods. Concerning the respective lengths of these periods we have no certain knowledge, but it is probable that the intervals when there are no ova capable of being fertilized are at least as long, if not longer, than those in which there are such ova.

In other words, assuming, as we may do, that the discharge of ova from the ovary occurs at the time of the menstrual period, and that these ova retain their vitality for from ten to fourteen days (a pure assumption), there would be an interval of two and a half to two weeks before the next menstrual period—*i. e.*, the next discharge of ova, during which interval there would be no fertilizable ova in the oviduct and consequently during which impregnation could not occur.

However, if we consider the problem from the other side, the combined testimony of almost all authors who have of late years dealt with the subject shows conclusively that pregnancy *may* result from copulation effected at any time as regards the menstrual periods, but that the probability of its occurring varies much according to the period as regards menstruation at which copulation is allowed.

Concerning the most favorable period for impregnation to be effected Dr. Montgomery says: "My own observations lead me to the conclusion that conception occurs, in the great majority of instances, within the first week after the menstrual discharge," a statement which is abundantly confirmed by other writers. The experience of the Jewish nation is about the best evidence available. It is very strong. The women keep aloof from marital intercourse until they have "taken the bath"—*i. e.*, just after menstruation. Their calculations, based upon the first intercourse being fruitful, are generally correct. In this case there can be little doubt that the ovum which is fertilized is the one discharged at the time of the immediately preceding menstrual period, as such an ovum would probably reach the uterus just as the new decidua was commencing to be formed within it, which would clearly be a favorable condition for its future development.

Conception following copulation effected a short time—a week or ten days

—before the menstrual period, is probably to be explained as due to the spermatozoa retaining their vitality until the occurrence of the period of discharge of the ovum, which they then fertilize.

The above account is avowedly imperfect, and any description of these processes must remain so until we obtain more satisfactory knowledge than we possess at present on the following points: (1) The time normally taken by the spermatozoa to work their way up the uterus and Fallopian tube; (2) the duration of vitality of the ovum; (3) the duration of vitality of the spermatozoa.

The one inference of importance which we may safely draw from the fact that conception may follow copulation effected at any time is, that no one of the varying conditions of the uterus during the different phases of menstruation offers any insuperable obstacle to the passage of the spermatozoa into the Fallopian tube.

General Account of Mammalian Development.—The earliest stages in the development of the fertilized human ovum have not yet been seen at all, and several of the later stages are only very imperfectly known. Inasmuch as a general knowledge of these early and intermediate stages is absolutely essential to the proper understanding of the structure of such early human embryos as have been described, a short general account of the leading features in the development of mammalian animals will be useful here, while the development of the human embryo itself will be dealt with in the next chapter.

SEGMENTATION OF OVUM.—The changes that immediately follow impregnation are best known to us, through the researches of Bischoff and Van Beneden, as they occur in the rabbit. The ovum is fertilized in the upper part of the Fallopian tube, down which it travels slowly to the uterus, which it reaches in three days. During its passage it is still invested by the *zona radiata*, and receives, in addition, from the walls of the tube an outer albuminous envelope. The changes that are undergone by the ovum during its passage down the Fallopian tube are commonly spoken of as the segmentation of the ovum, and are of the following nature:

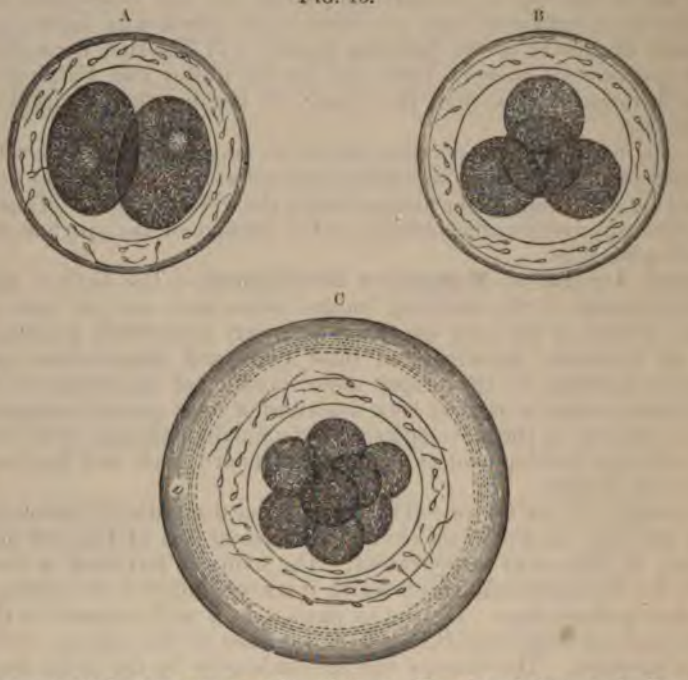
A few hours after fertilization is effected the whole ovum divides into two very nearly equal portions (Fig. 15, A); a little later each of the two divides again, and then each of the four; so that we get, in place of the original single sphere (Fig. 14), eight spherical bodies, of which four are slightly larger than the other four (Fig. 15, C). Each of the eight again dividing, we get sixteen, of which the eight larger ones—which we shall speak of as epiblast cells—become arranged round and partially enclose the eight smaller or hypoblast cells. Both sets of cells go on multiplying, and at about the end of the third day after impregnation, when the ovum passes from the Fallopian tube into the uterus, it has the structure shown in Fig. 16, A. It is still spherical, 0.09 mm. in diameter, and very little, if at all, larger than at the time of escape from the Graafian follicle; but instead of being one single cell, it consists of an outer layer of epiblast cells, almost completely surrounding a central mass of hypoblast cells.

This phenomenon of segmentation, always the first process in the development of an egg, is clearly a process of cell multiplication by fission; and it is almost certain that the nucleus plays the same part here that it does in ordinary cell division—*i. e.*, that before the whole ovum divides into two the nucleus divides first, and that at every subsequent division the nucleus divides before the cell itself, so that the nuclei of the cells shown in Fig. 16 are derived by fission from that of the fertilized ovum.

If we consider that the ovum is a single cell, and that from that single cell the embryo, with its various tissues, epidermis, muscle, nerves, etc.,

themselves all composed of cells, has to be derived, we shall not be surprised to find that the very first thing the ovum does in developing is to give rise

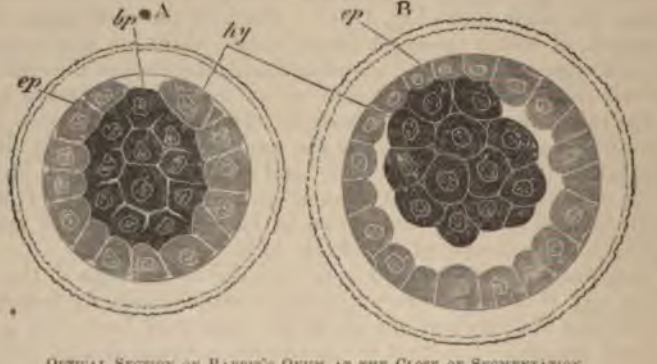
FIG. 15.



THREE STAGES IN THE SEGMENTATION OF THE RABBIT'S OVUM. (From QUAIN'S *Anatomy*, after BISCHOFF.

A. Shows the division of the ovum into two nearly equal masses.
B. The formation of four spheres by division of the two of the preceding stage.
C. The stage with eight segmentation spheres.

FIG. 16.



OPTICAL SECTION OF RABBIT'S OVUM AT THE CLOSE OF SEGMENTATION.
(From BALFOUR, after ED. VAN BENEDEN.)

ep. Epiblast. *hy*. Primitive hypoblast. *bp*. Spot where the epiblast has not yet grown over the hypoblast.

by fission to a heap of cells—to convert itself from a unicellular to a multicellular condition.

THE BLASTODERMIC VESICLE.—Having reached the uterus, the epiblast cells first grow over the hypoblast cells so as to enclose them completely, and then a narrow cavity, crescentic in section, appears between the epiblast and hypoblast (Fig. 16, B), extending nearly, but not quite, all round. The epiblast, and consequently the whole ovum, now grows very rapidly, and during the fourth day acquires the appearance shown in Fig. 17. It is now a thin-walled spherical sac, about 0.28 mm. in diameter—the so-called *blastodermic vesicle*. Its wall consists of a thin layer of flattened epiblast cells, and attached to its inner surface at one part is a lenticular mass formed by the hypoblast cells. If the ovum be looked on from above, this patch of hypoblast will give rise to an opaque circular spot—the *embryonic area*.

FIG. 17.

RABBIT'S OVUM BETWEEN SEVENTY AND NINETY HOURS AFTER IMPREGNATION.
(From BALFOUR, after ED. VAN BENEDEN.)

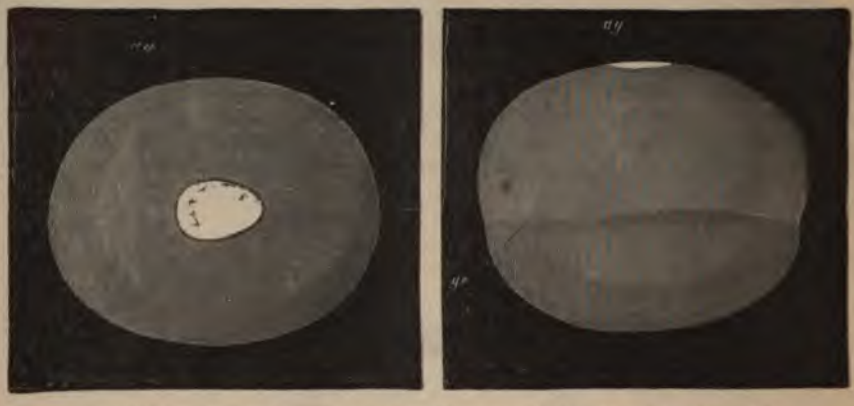
bv. Cavity of blastodermic vesicle. *ep*. Epiblast, *hy*. Primitive hypoblast. *zp*. Zona pellucida.

The blastodermic vesicle still continues to grow rapidly; the circular patch of hypoblast also grows all round its edge, and so extends further and further round the inside of the vesicle; and in the embryonic area a third layer of cells—the mesoblast—appears between the epiblast and hypoblast. The appearance of the blastodermic vesicle on the seventh day is shown in Fig. 18. The central white spot is the embryonic area; this is now somewhat pear-shaped, and consists of all three layers of cells—epiblast, mesoblast, and hypoblast. The rest of the upper half of the vesicle consists of two layers, epiblast and hypoblast, the slight constriction round the middle of the vesicle, seen in the right-hand figure, marking the limit to which the hypoblast has extended; and, finally, the lower half of the vesicle, below the constriction, consists of epiblast alone. The whole vesicle is still invested by the *zona pellucida*, which is not shown in the figure.[1]

[1] The actual formation of the three germinal layers of the rabbit is probably not so simple as is described above, and is not yet thoroughly understood. According to Balfour and Keepe, the "hypoblast" cells of Figs. 16 and 17 divide into two layers, whereof the upper fuses with the epiblast, of which it becomes part, while the lower layer remains as the definite hypoblast of the embryo. The mesoblast, which appears later than the other two layers, is formed partly from epiblast and partly from hypoblast.

FORMATION OF THE EMBRYO.—During the seventh day a narrow opaque patch—the *primitive streak*—appears in the posterior half of the embryonic

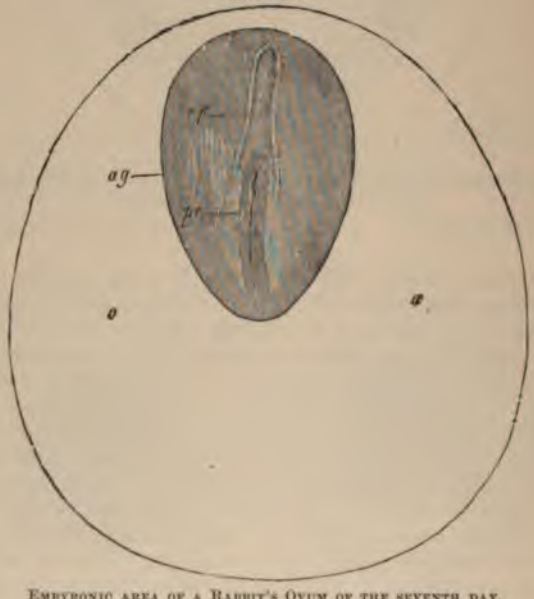
FIG. 18.



DIAGRAMMATIC VIEWS OF THE BLASTODERMIC VESICLE OF A RABBIT ON THE SEVENTH DAY.
(From BALFOUR, after ED. v. BENEDEN.)

In the left-hand figure, the vesicle is seen from above; in the right-hand figure, from the side. The white patch (*ag*) is the germinal area; and the slight constriction (*ge*) marks the limit to which the hypoblast has extended.

FIG. 19.



EMBRYONIC AREA OF A RABBIT'S OVUM OF THE SEVENTH DAY.
(From KÖLLIKER.)

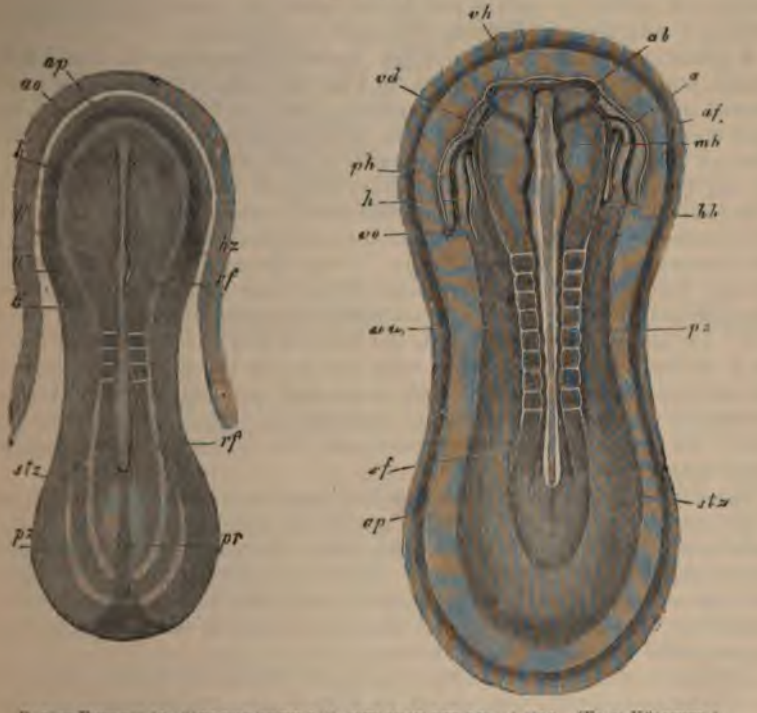
The shaded part (*ag*) is the embryonic area. *OO* is the region of the blastodermic vesicle immediately surrounding the embryonic area, into which the mesoblast has already spread, and in which bloodvessels will shortly appear. *pr.* Primitive streak. *rf.* Medullary groove.

area; and in front of this streak there is formed, on the eighth day, a shallow median groove—the *medullary groove* (Fig. 19), bounded by two folds—the

medullary folds. This groove rapidly deepens; the two folds bounding it bend over towards one another, meet and fuse, thereby converting the groove into a closed tubular canal—the *neural canal*—which is the rudiment of the central nervous system, one of the very earliest systems to appear in the embryo, and which becomes differentiated into the brain in front and spinal cord behind. From the mode of its formation—at first an open groove—it is clearly lined by, and indeed formed from the epiblast, the most superficial of the three layers of the embryonic area.

At the sides of this medullary or neural canal, about the ninth day, the mesoblast becomes divided into a number of somewhat cubical masses arranged in a linear series on either side of the middle line; these masses (Fig. 20) are the protovertebræ, and the transverse lines between them mark the division of the body into segments or somites.

FIG. 20.



RABBIT EMBRYO OF ABOUT THE NINTH DAY, SEEN FROM THE DORSAL SIDE. (From KÖLLIKER.)

ob. Optic vesicle. *af.* Amnion. *ap.* Area pellucida. *h* and *hz.* Heart. *h'.* Medullary plate in region of future forebrain. *h''.* Medullary plate in region of future midbrain. *kk* and *h'''.* Hindbrain. *mh.* Midbrain. *ph.* Pericardial section of body-cavity. *pz.* Lateral zone. *pr.* Primitive streak. *rf.* Medullary groove. *str.* Vertebral zone. *uw.* Protovertebræ. *vh.* Forebrain. *vo.* Vitelline vein.

We thus see that the formation of the embryo commences in the embryonic area of the blastodermic vesicle; and, further, that if the vesicle be placed with the embryonic area upwards, as in the right-hand figure of Fig. 18, then the dorsal surface of the embryo, indicated by the central nervous system, will be directed upwards; and the ventral surface downwards—*i. e.*, towards the cavity of the blastodermic vesicle. The head end is indicated in Fig. 20, by the dilatations of the neural canal forming the lobes of the brain, and

notably by the two large lateral outgrowths from its front end which form the optic vesicles.

YOLK SAC, OR UMBILICAL VESICLE.—Not only does the development of the embryo commence in the embryonic area, it is also confined to it. About the ninth day the embryo begins to be marked off by a slight constriction from the rest of the blastodermic vesicle. This constriction commences first and is most marked at the anterior end of the embryo, where it receives the name of the head-fold; it is more prominent at the posterior end or tail-fold than at the sides. Its effect, well shown in Fig. 22, 2, is gradually to pinch off the embryonic portion from the rest of the blastodermic vesicle, which forms then a thin-walled sac filled with fluid, and connected with the embryo by a stalk, which, at first short and wide (Fig. 22, 2), becomes, as the constriction deepens (Fig. 22, 4, 5), longer and narrower.

The portion of the blastodermic vesicle which is separated in this way from the embryonic portion, and takes no direct part in the formation of the embryo, is spoken of as the *yolk-sac* or *umbilical vesicle*, and the stalk connecting it with the embryo may be called the *yolk-stalk*.

ALIMENTARY CANAL.—From the mode of formation of this umbilical vesicle, and from an examination of Fig. 22, it is clear that there will be formed underneath the embryo a cavity closed in front and behind by the head and tail folds, but opening freely in the middle portion of its length through the yolk-stalk into the cavity of the umbilical vesicle—*i. e.*, into the cavity of the original blastodermic vesicle, of which it is really a portion. This cavity, which it is also clear from the figures is lined by the hypoblast, or lowermost of the three layers of the embryonic area, is the rudiment of the alimentary canal of the embryo. From the mode of its development it is clear that there is at first neither mouth nor anus, that the alimentary canal, indeed, has at this stage no communication whatever with the exterior. Its communication through the yolk-stalk with the cavity of the yolk-sac is at first (Fig. 22, 2) a very wide one, but as the constriction separating the embryo from the yolk-sac gets more and more marked, the yolk-stalk necessarily becomes narrower and narrower (*cf.* Fig. 22, 3, 4, 5), until ultimately its cavity becomes obliterated, and the alimentary canal becomes a completely closed tube.

The mouth and anus develop at a comparatively late period as pittings-in of the surface of the body, which gradually deepen until they meet with and open into the alimentary canal, which then first acquires its definite communications with the exterior. The mouth opening is formed before the anal one, which is usually not completed until very late in development. In exceptional cases it may not be formed at the time of birth, thus giving rise to congenital occlusion of the rectum.

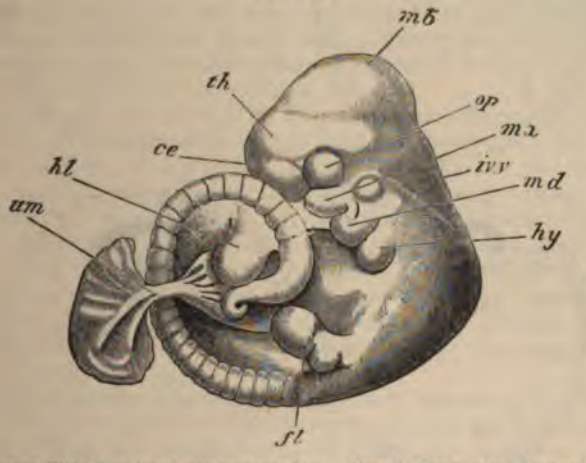
The whole embryo now grows rapidly, and about the twelfth day acquires the shape and appearance shown in Fig. 21, the rudiments of all the important organs being by this time established. The embryo is no longer straight, but is very strongly bent on itself, the dorsal surface being convex and the ventral concave; the head end is disproportionately large, as, indeed, it is throughout the whole of development; in the neck a series of transverse ridges, the *visceral arches*, have appeared, and between these are slits, the *visceral clefts*, which lead into the alimentary canal, and so place it in communication with the exterior. Of the visceral arches the most anterior pair (Fig. 21, *m x*) lie at the sides of the mouth and form the basis of the upper jaw; the second pair (Fig. 21, *m d*) bound the mouth behind and give rise to the lower jaw; while the third pair (Fig. 21, *h y*) form ultimately part of the hyoidean apparatus.

Rudiments of eyes (Fig. 21, *o p*) and ears are present, as are also both

pairs of limbs (Fig. 21, *f l*, *b l*) in the form of simple buds, presenting as yet little or no trace of subdivision into segments.

THE EMBRYONIC MEMBRANES.—We have now to consider certain structures which, though not forming any actual part of the embryo itself, or only doing so to a very limited extent, yet play an exceedingly important part in its development. Together with the formation of these embryonic

FIG. 21.



RABBIT EMBRYO OF ABOUT THE TWELFTH DAY. (From BALFOUR, after WELDON.)

ce. Cerebral hemisphere. *fl.* Forelimb. *hl.* Hindlimb. *hy.* Hyoid arch. *iv.v.* Fourth ventricle. *mb.* Midbrain. *mx.* Maxillary arch. *md.* Mandibular arch. *op.* Eye. *th.* Thalamencephalon. *um.* Umbilical stalk.

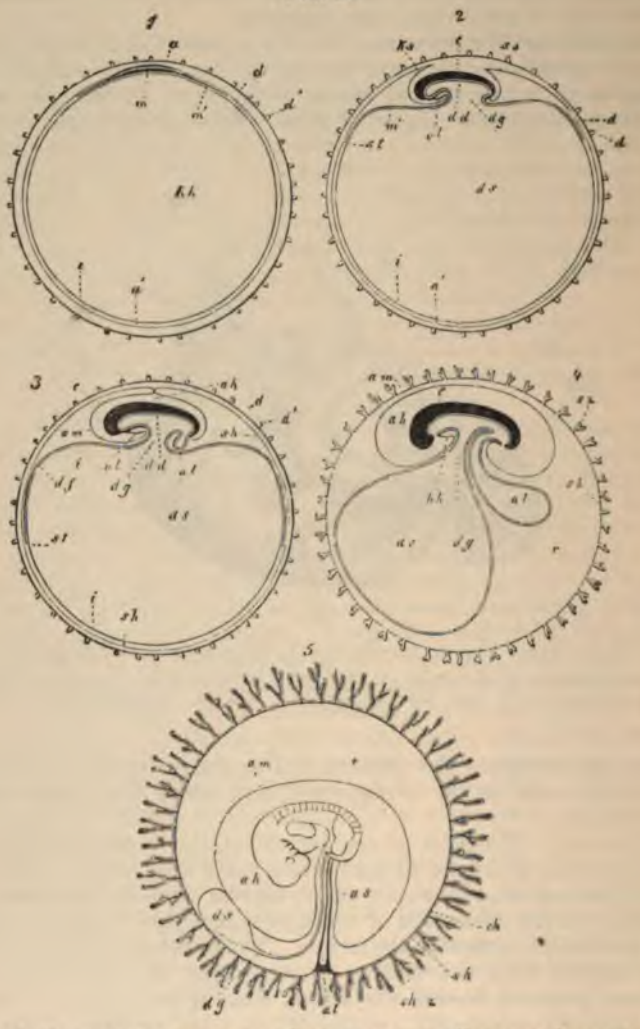
membranes on the side of the ovum, it will be convenient to consider certain changes which occur in the uterus itself, and which are closely connected with the former.

THE DECIDUA.—Previous to the arrival of the ovum the lining membrane of the whole of the uterus has become much swollen and very vascular, and has undergone other changes, which will be more fully described hereafter, leading to the formation of what is called the *decidua*, a membrane specially developed to receive the ovum. The ovum on entering the uterus comes in contact with the *decidua* at some spot, and adheres to it; the *decidua* soon grows up around the ovum, forming at first a low wall round it, and ultimately completely enveloping it. The portion of the *decidua* which grows over the ovum in this way receives the name *decidua reflexa;* the part with which the ovum first came in contact is the *decidua serotina;* and the part lining the rest of the uterus, the *decidua vera;* this latter is of no further use, and soon disappears; it is apparently only developed because it is uncertain with what portion of the uterus the ovum will first come in contact, and consequently all parts must be ready to receive it.

The ovum embedded in the *decidua reflexa* at first occupies but a small portion of the cavity of the uterus, but owing to its rapid growth it soon fills the greater part, and ultimately, in woman, the whole of the uterus, the *decidua reflexa* coming in contact with the *decidua vera*. A stage shortly before the occurrence of this event is shown for the human embryo in Fig. 37.

We now return to the ovum itself. At the stage represented in Fig. 22, 1, which is slightly older than that in Fig. 18, the ovum or blastodermic vesicle

FIG. 22



DIAGRAMMATIC FIGURES, ILLUSTRATING THE DEVELOPMENT OF THE MAMMALIAN EMBRYO AND THE FŒTAL MEMBRANE (From KÖLLIKER.)

1. The blastodermic vesicle invested in the zona pellucida, and showing at its upper pole the embryonic area.
2. Shows the pinching off the embryo from the yolk-sac, and the formation of the amnion.
3. Further development of amnion, and commencement of allantois.
4. Completion of amnion, and growth of allantois. The false amnion, or subgonal membrane, gives off villous processes.
5. The allantois has grown all round the vesicle, and gives off processes into the villi which are much larger than before. The yolk-sac is greatly reduced in size.

a. Epiblast of embryo. *a'*. Epiblast of non-embryonic part of blastodermic vesicle. *al*. Allantois. *am*. Amnion. *ch*. Chorion. *ch* 2. Chorionic villi. *d*. Zona pellucida. *d'*. Processes of zona. *dd*. Embryonic hypoblast. *df*. Area vasculosa. *dg*. Yolk-stalk. *ds*. Yolk-sac. *e*. Embryo. *hh* Pericardial cavity. *i*. Non-embryonic hypoblast. *kh* Cavity of blastodermic vesicle. *ks* Head-fold of amnion. *m*. Embryonic mesoblast. *s*. Non-embryonic mesoblast. *r*. Space between true and false amnion. *sh*. False amnion, or subgonal membranes. *ss*. Vail-fold of amnion. *st*. Sinus terminalis. *zl*. Processes of zona pellucida. *vl*. Ventral body-wall of embryo.

is completely surrounded by the *decidua reflexa*, and has the following structure. The whole vesicle is invested in the *zona pellucida*, which gives off from its outer surface a number of little processes or villi (Fig. 22), which fit into little depressions in the *decidua reflexa*. The blastodermic vesicle itself presents in the embryonic area all three layers, epiblast, mesoblast, and hypoblast, and as shown in the figure the mesoblast has extended a little way beyond the embryonic area, so that surrounding this area is a ring in which, as in the area itself, all three layers are present. The rest of the vesicle consists of two layers, epiblast (or ectoderm of Kölliker) and hypoblast (entoderm, Kölliker), the latter having now grown so as to line the whole of the vesicle (*cf.* the earlier stage represented in Fig. 18, in which it has only extended about half-way round).

Splitting of Mesoblast.—The mesoblast (mesoderm, Kölliker) continues to spread by growth at its margin, and ultimately, like the hypoblast, extends completely round the vesicle. About the time of the first appearance of the constriction separating the embryo from the yolk-sac, the mesoblast splits into two layers. Owing to this splitting, which takes place in the marginal though not in the axial part of the embryonic area, as well as in the part of the mesoblast outside the embryo, the portion of the blastodermic vesicle in which it occurs consists now of four instead of three layers—*i. e.*, first, the epiblast; secondly, the upper or *somatic* layer of the mesoblast; thirdly, the lower or *splanchnic* layer of the mesoblast; and, fourthly, the hypoblast.

The upper or somatic layer of the mesoblast becomes very closely connected with the epiblast, the two together practically forming a single layer, which is spoken of as the *somatopleure*. Similarly the lower or splanchnic layer of the mesoblast becomes intimately connected with the hypoblast, with which it forms what is practically a single layer—the *splanchnopleure*.

The Body-cavity.—In the embryo itself the somatopleure forms the lateral and ventral portions of the body wall, while the splanchnopleure forms the similar portions of the wall of the alimentary canal. The space between somatopleure and splanchnopleure—*i. e.*, the actual split between the two layers of the mesoblast—becomes the pleuroperitoneal or body-cavity of the embryo. These relations will become more evident from an inspection of Fig. 23.

The Amnion.—Outside the embryo the somatopleure rises up so as to form a low wall surrounding the embryonic area. This wall, which receives the name of amnion, rapidly increases in height (Fig. 22, 2), and the folds forming it arch over the back of the embryo so as partially to cover it. A little later the folds meet one another along the middle line of the back, and so completely cover the embryo (Fig. 22, 3). At this period we have an inner layer of the amnion (Fig. 22, 3, *a m*) closely investing the embryo, and an outer layer (Fig. 22, 3, *s h*) lying immediately beneath the *zona pellucida*, and continuous below with the outer wall of the yolk-sac, *d s*.

A little later still the two layers of the amnion coalesce along their line of meeting above the back of the embryo, and the inner layer becomes completely separated from the outer layer (Fig. 23). At the same time, owing to the splitting of the mesoblast extending all round the yolk-sac, the outer layer of the amnion becomes completely separated from the yolk-sac, and now forms a thin lining membrane closely applied to the inner surface of the *zona pellucida*.

The condition of things at this stage is shown in Figs. 22, 4, and 23. The outer layer of the amnion, *s h* in Fig. 22, 4, and *s z* in Fig. 23, lining the *zona pellucida*, sometimes receives the name *false amnion*, but is better called the *subzonal membrane;* the inner layer *a m*, which forms an investment over

the back of the embryo, but at some little distance from it, and which is clearly, from its mode of formation as a fold of somatopleura, continuous with the body wall of the embryo, is spoken of as the *true amnion*, or simply as *the amnion*.

It will further be evident from the figures that the space between the two layers of the amnion *r* in Fig. 22, 4, being part of the space formed by the splitting of the mesoblast, is continuous with the body-cavity of the embryo.

It is customary to speak of the space between the inner layer of the amnion and the embryo, A C in Fig. 23, which is really not between the layers of the amnion at all, as the *amnionic cavity*.

FIG. 23.

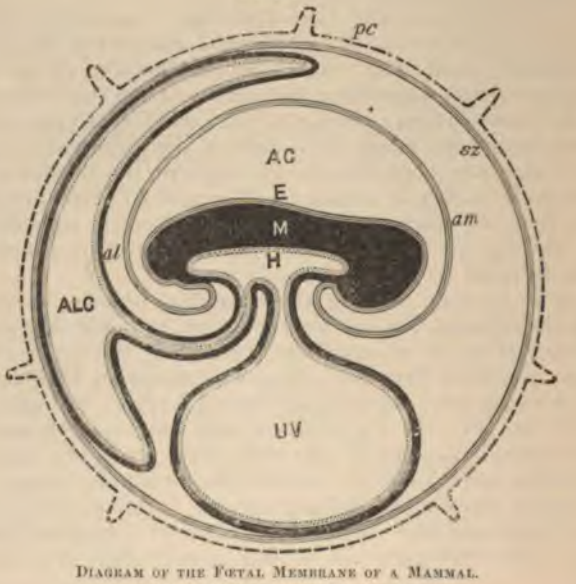


DIAGRAM OF THE FŒTAL MEMBRANE OF A MAMMAL.
(From BALFOUR, after TURNER.)

Structures which either are or have been, at an earlier period of development, continuous with one another, are represented by the same character of shading.

AC. Amnionic cavity. ALC. Allantoic cavity. *al*. Allantois. *am*. Amnion. E. Epiblast of embryo. H. Hypoblast of embryo. M. Mesoblast of embryo. *pc*. Zona, with villi. *sz*. False amnion or subzonal membrane. UV. Yolk-sac or umbilical vesicle.

THE ALLANTOIS.—During the growth of the amnion a small hollow bud grows out from the ventral surface of the alimentary canal close to its posterior extremity. This is known as the *allantois* (Fig. 22, 3). As it is an outgrowth of the alimentary canal, its walls must consist, like those of the alimentary canal itself, of splanchnopleure—*i. e.*, of an outer layer formed by the splanchnic layer of the mesoblast, and an inner lining of hypoblast.

The allantois hangs down at first into the body-cavity; it grows rapidly, and soon passes out beyond the embryo into the space between the two layers of the amnion, which space we have already seen to be directly continuous with the body-cavity of the embryo (*cf.* Figs. 22, 4, and 23). Continuing its growth, it comes in contact with the subzonal membrane, and then spreads out so as to form an inner lining to this membrane, which, growing at its edge, ultimately extends round the whole or greater part of the ovum (cf. Figs. 22, 5, and 23).

THE CHORION.—The outer wall of the ovum now consists of three layers—viz., the *zona pellucida* on the outside; inside that, the subzonal membrane or false amnion; and inside that again, the allantois. These three layers, originally distinct, soon become fused completely with one another, and are spoken of collectively as the *chorion*.

THE VASCULAR SYSTEM OF THE EMBRYO.—Bloodvessels are developed in the embryo at a very early period. The heart appears in an embryo of about the age represented in Fig. 22, 2—*i. e.*, shortly after the commencement of the constriction separating the embryo from the yolk-sac, as a pair of tubes one on either side of the body; these soon meet one another and fuse underneath the throat to form a single tubular heart, in connection with which are vessels developed in the mesoblast both of the embryo and of the yolk-sac.

CIRCULATION OF THE YOLK-SAC.—The heart very soon commences beating: it drives the blood forwards through a series of aortic arches on either side, whereof one is situated in each of the visceral arches already described; from these some of the blood goes forwards to the head, but the greater part is sent back to the hinder part of the body along a couple of arteries, the dorsal aortæ, which subsequently unite together to form the single dorsal aorta of the adult. From the dorsal aortæ vitelline arteries take the blood to a network of vessels developed in the mesoblast of the yolk-sac, and from these it is returned to the posterior end of the heart by vitelline veins.

CIRCULATION IN ALLANTOIS.—The allantois is from its earliest appearance very vascular, and its bloodvessels increase very rapidly in size as it develops. Two very large branches from the posterior end of the dorsal aorta, the allantoic or umbilical arteries, carry blood to it from the embryo, and a couple of umbilical veins return it back again to the heart of the embryo.

THE PLACENTA.—At the stage represented in Fig. 22, 4, it will be remembered that the whole ovum is embedded in the *decidua reflexa* formed by the mucous membrane of the uterus of the mother. The outer wall of the ovum or blastodermic vesicle is formed by the *zona pellucida* and the subzonal membrane, and its outer surface is studded with small processes or villi (Fig. 22, 4, *sz*) which fit into corresponding depressions or pits in the *decidua reflexa*, and so serve to connect the two structures moderately firmly together.

As the allantois develops these villi become larger and often branch, and when the chorion is established by the allantois reaching the subzonal membrane and spreading out so as to form an inner lining to it, vascular processes from the allantois penetrate into the villi (Fig. 22, 5). At the same time the maternal vessels in the *decidua reflexa* surrounding the ovum become very greatly developed. In this way it comes to pass that the prolongations of the bloodvessels of the embryo contained in the villi of the chorion come into very close proximity with the bloodvessels of the mother contained in the *decidua reflexa*—*i. e.*, the mucous membrane of the uterus; and the two sets of structures, fœtal and maternal, that are thus brought into close relation with one another, together make up what is called the *placenta*.

There is never direct continuity between the fœtal and maternal vessels, yet the two lie so close together side by side that an exchange of contents can take place through the walls of the bloodvessels; and in this way the fœtal blood receives nutrient matter from the blood of the mother, and sends it by the umbilical veins to the embryo to serve for its nutrition and growth; while, on the other hand, the excess of effete matter in the blood of the fœtus passess into that of the mother and is so got rid of.

The fœtus villi are at first (Fig. 22, 5) uniformly distributed all over the chorion; but, after a time (Fig. 45), they become in the human species much smaller in the region of the *decidua reflexa* and ultimately disappear from this part. To compensate for this loss they attain a very much higher

development in the part where they remain, that part which we have called decidua serotina. Here both the fœtal and maternal structures exhibit very *great complexity*; the maternal vessels dilate enormously so as to form large *sinuses*, while the fœtal villi branch and subdivide so as to form extremely *complex tufts*, which push the walls of the maternal sinuses before them, and *so hang down into* these sinuses bathed on all sides by the maternal blood.

The *relations* between the fœtal villi and the maternal portion of the placenta are *now so* intricate that the former cannot be simply pulled away from the latter at birth, as occurs in many of the lower mammals, but the fœtal *portion drags* away with it considerable portions of the maternal part; this *necessarily causes* rupture of the large sinuses containing the maternal blood, *and so leads* to the hæmorrhage that invariably accompanies parturition in *woman.*

Umbilical Stalk.—The amnion, which at first invests the embryo tolerably closely, later on grows rapidly so as to leave a considerable space—the amnionic cavity—between the embryo and itself. As shown in Fig. 22, 5, the amnion as it recedes from the embryo forms an investment to the stalk of the allantois; and it is further evident from the figure that, in addition to the allantoic stalk, the yolk-stalk will also be included in this investment. The compound stalk formed in this way, which includes both the allantoic stalk with the placental vessels and the yolk-stalk with its vessels, and is ensheathed, as stated above, by the amnion, receives the name of *umbilical stalk*. It serves, as shown in Figs. 22, 5, and 45, to attach the embryo to the placenta.

Bladder and Urachus.—It will be remembered that the allantois was at first a *hollow* bud, its cavity communicating with the alimentary canal, of which it was indeed a diverticulum (Fig. 22); the cavity soon becomes lost in the placenta itself, if, indeed, it is ever present there; it may persist in the umbilical stalk, more or less completely, throughout development; within the body of the embryo the portion of the cavity next to the alimentary canal becomes ultimately the urinary bladder, while the portion of the stalk extending from this part to the body wall of the embryo becomes the urachus.

Fate of the Germinal Layers.—It will be convenient to conclude this chapter with a very brief account of the ultimate fate of each of the three germinal layers of which the embryonic area consisted at a very early stage, viz., epiblast, mesoblast, and hypoblast.

In the first place, it will be noticed that out of one or other of these three layers every portion of the body of the embryo or fœtus is derived, directly or indirectly.

The epiblast, which is clearly the most superficial layer of the three, gives rise to the epidermis covering the whole of the body, and also, as we have seen, to the whole of the central nervous system, both brain and spinal cord, and indeed to the nerves themselves inasmuch as these arise as outgrowths from the central nervous system. It also forms the lining of the mouth and anus, which as already noticed are pittings-in from the exterior; and it takes a very important share in the formation of the organs of special sense.

The hypoblast, or lowermost of the three layers, forms the epithelium lining the alimentary canal and its glands, and also that lining the bronchi and lungs, which arise as diverticula of the alimentary canal. It also forms a longitudinal solid rod—the notochord—which runs the whole length of the body underneath the central nervous system in the position afterwards held by the vertebral centre and the base of the skull.

The mesoblast forms all the rest of the body: muscles, bones, connective tissue, and bloodvessels, wherever they occur, are mesoblastic; also the peritoneal epithelium and the urinary and reproductive organs.

CHAPTER IV.

DEVELOPMENT OF THE HUMAN EMBRYO AND FŒTUS.

CONCERNING the early development of the human embryo, our knowledge is still in a very unsatisfactory condition. Of the stages passed through during the first fortnight after impregnation we know exceedingly little, and those occupying the third week are only very imperfectly known to us; but from the end of the third week onwards the various stages of development have been tolerably fully and satisfactorily described.

For reasons stated in the preface, we shall here give a brief account of such early stages as have been described, and endeavor, by the aid of the facts set forth in the preceding chapter, to frame something approaching to a consistent account of the development of the human embryo from the ovum.

Estimation of Age of Embryos.—A preliminary difficulty, and one that cannot be satisfactorily disposed of at present, lies in the fact that, after we have obtained an embryo, we have no really trustworthy means of determining its exact age. One of the most constant accompaniments of pregnancy is cessation of menstruation; and His, one of the greatest authorities on the subject, considers that this fact affords the most trustworthy basis for estimating the age of embryos. He lays down the following rule:[1] The age of an embryo is the time that has elapsed since the first day of the first omitted period. Thus, supposing the commencement of a period to be due on January 5, and that when this time comes the period is omitted, but some time subsequently, say February 9, an embryo is aborted; then the age of that embryo would be, according to His, the interval between January 5 and February 9—*i. e.*, five weeks.

In arriving at this result His argues in the following manner: The ovum leaves the ovary either at or shortly before the menstrual period; if fertilized, presumably by spermatozoa previously introduced, menstruation does not occur; but the changes in the uterine mucous membrane, instead of, as usual, becoming retrogressive, continue to be progressive, and so prepare the uterus for the reception of the ovum. Hence the first omitted menstrual period corresponds in point of time with the fertilization of the ovum; and hence the age of the embryo may be taken as the time that has elapsed since the first omitted period.

This method of calculation is, however, open to very grave objections. We have seen in the preceding chapter that there is much reason for thinking that the decidual membrane, which is broken up and discharged at the menstrual period, is prepared for the reception, not of the ovum which is liberated from the ovary at the time of the period, but of the ovum set free at the last preceding period. The process of fatty degeneration associated with the break-up and discharge of the decidua has almost certainly commenced before the occurrence of the period; and it is almost inconceivable that the mere act of fertilization at the commencement of the Fallopian tube of an ovum

[1] His, Anatomie Menschlicher Embryonen. To this very important and beautifully illustrated work, which has been freely used in compiling the present chapter, the reader is referred for more detailed descriptions of the development of the human embryo than can be given here.

which, in all probability will not reach the uterus for at least a week, should be able to arrest the degenerative changes already commenced in the decidua, stop suddenly the menstrual discharge that is on the verge of taking place, and convert the retrogressive changes of the decidua into progressive ones. His's theory also does not accord with the well-established fact that, in order to insure pregnancy, the most favorable time for copulation is shortly after the period, in which case fertilization and the commencement of development of the ovum could hardly be coincident with the first omitted period.

For these reasons the theory advocated by Pflüger and others appears preferable, according to which the decidua discharged at any period is not related to the ovum set free at that period, but to the ovum liberated at the immediately preceding period. On this view, however, we are left absolutely without means of determining the age of embryos; and although an exact determination is immaterial in the case of later embryos, yet when we are dealing with early ones it is a point of great importance.

Partly for this reason, and partly because it has hitherto been customary to calculate the age according to the system of which His is the most recent advocate, we shall in this chapter give the ages estimated in this manner—*i. e.*, by the age of an embryo will be meant the interval between the first day of the first omitted period and the time at which the embryo is discharged from the uterus. It must be repeated, however, that this method of calculation can only be justified by its general adoption, its readiness of application, and most of all by the fact that no other precise system has yet been proposed. Viewed on its own merits the method is not only imperfect, but is even opposed to many well-established facts.

The First Week.—The process of segmentation in the human ovum has not yet been seen. It is, however, in the highest degree probable that segmentation takes place during the passage of the ovum along the Fallopian tube, and that it is effected in a manner practically identical with that described in the preceding chapter in the case of the rabbit.

Neither do we know the length of time taken by the human ovum to travel down the Fallopian tube to the uterus. According to the best authorities this passage "probably occupies not less than eight days in the human subject." In the rabbit we have seen that the uterus is reached on the third day, so that either the process of development must from the first be much slower in the human embryo than in the rabbit, or else the human ovum must enter the uterus in a far more advanced condition than happens in the case of the rabbit. Such evidence as we have points rather in favor of the former alternative.

Second Week.—Of embryos towards the close of the second week of development, a few examples have been described; but there is some doubt whether any of these few can be regarded as perfectly normal.

Reichert's Embryo.—The best known instance is an ovum described by Reichert, and estimated to be of about the thirteenth day.

This ovum, which is represented four times the natural size in Figs. 24 and 25, was found *in situ* in the uterus of a woman who had committed suicide. There was a fully formed *decidua reflexa*, within which was the ovum itself (Figs. 24 and 25), a vesicular body of the shape shown in the figure, measuring 5.5 mm. along its greater diameter, and 3.3 mm. from side to side. Of the two sides the one turned towards the uterus (the upper surface in Fig. 25), was more convex than the opposite side, facing the *decidua reflexa*. The margin of the vesicle, as shown in the figure, was thickly fringed with villi, the largest of which were 0.2 mm. long, and slightly branched. The villi were absent both from the uterine surface and from the opposite one, leaving two bare circular patches. In the middle of the uterine patch was a smaller

circular spot of a darker color, 1.6 mm. in diameter, and indicated in the figure.

Not the slightest trace of any embryonic structure was discovered; there was no indication of either primitive or medullary grooves. The wall of the vesicle is described as consisting of a single layer of epithelial cells prolonged outwards to form the villi. In the circular patch on the uterine surface, which is spoken of as the germinal area, a second inner layer of finely granular cells was present. The cavity of the vesicle was occupied by a gelatinous fluid, traversed by a network of fine fibres, and containing within it a spherical body.

Ova of somewhat similar appearance, and of apparently about the same age, have been described by Wharton Jones, Breuss, Kollmann, and others; but in none of these cases was any trace of an embryo discovered. The chief points that we learn from these other specimens are, first, that the spherical

FIG. 24. FIG. 25.

FRONT AND SIDE VIEWS OF REICHERT'S OVUM. (From KÖLLIKER). × 4.

body described by Reichert is made up of nucleated cells, and is apparently solid and in connection with the germinal area; and, secondly, that it is highly probable that the wall of the vesicle really consists, not of a single layer, but of two layers, of which the inner one is of the nature of connective tissue, and *therefore of mesoblastic origin.*

It is not easy to make any satisfactory comparison between these ova and the stages already described as occurring in the rabbit, and the difficulty is much increased by the doubt we must feel as to whether the ova in question are perfectly normal, or are not to a greater or less extent pathological. As the different ova described appear, however, to agree in the most important points, it is advisable to make such comparisons as is possible between them and the more usual processes of mammalian development.

FIG. 26.

DIAGRAMMATIC SECTION OF REICHERT'S OVUM. (From HIS.) × 5.
a. The germinal area.

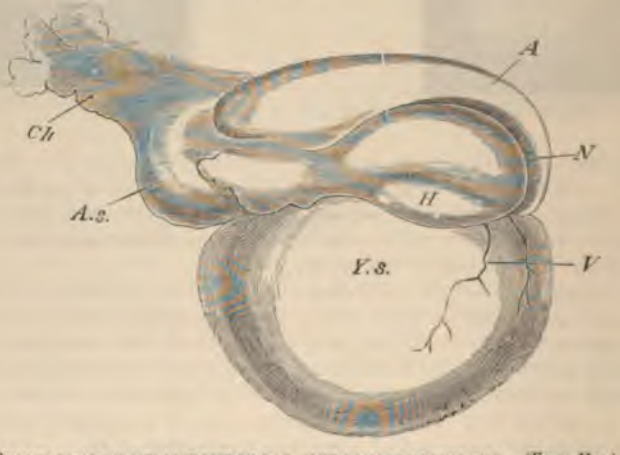
His considers that the stage reached by these ova is a very early one—but very little older, indeed, than that represented for the rabbit in Fig. 17; and he illustrates his views by the diagrammatic section of Reichert's ovum given above (Fig. 26).

He considers that the outer wall of the vesicle consists of epiblast alone; that hypoblast is present only in the germinal area, where it forms the inner layer described by Reichert; and that the spherical mass of cells is also hypoblast, and will afterwards become hollowed out and expanded to form the yolk-sack.

Against this interpretation it must be pointed out (1) that the stage in question is in the rabbit a very early one, and it would follow that, except in its much greater size, the human ovum on the thirteenth day has advanced no further than the rabbit's of the third day, which considering the usual rapidity of the early embryonic processes, would be at least very extraordinary; (2) that the evidence is very strong—indeed, practically conclusive—for thinking that the wall of the vesicle has in addition to the epiblast layer an inner connective-tissue lining, which is even described by some observers as vascular, and which must be of mesoblastic origin. It appears, therefore, certain that the stage reached is a considerably later one than supposed by His; and it is also clear that, if normal, it does not exactly correspond to any definite stage in the development of the rabbit.

The human ovum, indeed, would appear to be peculiar (1) in the unusually early[1] or "precocious" development of a layer of vascular mesoblast lining the blastodermic vesicle; and (2) in the very exceptionally late

FIG. 27.



HUMAN EMBRYO OF ABOUT THE FOURTEENTH DAY, SEEN FROM THE RIGHT SIDE. (From His.) × 20.

A. Amnion. *A.s.* Allantoic stalk, connecting the hinder end of the embryo with *Ch.* The Chorion. *H.* Heart. *N.* Medullary or neural groove. *V.* Bloodvessel of yolk-sac. *Y.s.* Yolk-sac.

appearance of definite rudiments of the embryo itself. It is extremely important that no opportunities of determining whether the latter feature is normal or pathological should be lost in future.

HIS'S EMBRYO E.—The youngest human ovum containing a distinct embryo is one obtained by His in 1869, and carefully described by him, and is at present deposited in the Anatomical Museum at Basle. This embryo, which is considered by His to be of about the fourteenth day, is represented magnified twenty diameters, in Fig. 27. The whole ovum is an oval vesicle, measuring along its greater diameter 8.5 mm., and along its lesser 5.5 mm.,

[1] Unusually early, not in point of absolute time, but relatively to the other processes of development. *Cf.* Balfour, Comparative Embryology, vol. ii. p. 225.

and covered all over with branched villi. The contained embryo is 2.1 mm. in length, and attached at its hinder end by a short thick stalk 0.5 mm. long to the inner surface of the vesicle. The embryo is separated by a very slight constriction—most marked at its anterior end—from the yolk-sac (Fig. 27, *Y.s.*), which measures 2.3 by 1.6 mm. Covering over the embryo, but at a short distance from it, is a membranous fold A, which is clearly the true amnion. The embryo itself presents on its dorsal surface a medullary groove, bounded by two prominent medullary folds; the only other organ visible is a slightly prominent fold between the embryo and yolk-sac (Fig. 27, *H*), probably the rudiment of the heart; two vessels arising close to this were traced over the yolk-sac.

Other embryos of apparently about the same age have been described by His, Allen Thomson, and others, which agree in their main features with that just noticed, and differ principally in being rather further advanced—the constriction between embryo and yolk-sac being more marked, the embryo itself being rather larger, and the medullary groove both deeper and longer.

On comparing these embryos with the corresponding stages of the rabbit, the most marked difference is seen to lie in the fact that the human embryo is already at this very early period connected with the chorion by a stalk, while in the rabbit this connection is not acquired till considerably later. This stalk is clearly the allantois, so that the difference might be expressed by saying that the allantois develops earlier in the human embryo than in the ordinary mammal. But this is not all. Not only does the allantois develop earlier; it also develops in a totally different manner. Usually among mammals the allantois arises, as we have seen above (*cf.* Fig. 22) as a hollow saccular outgrowth from the alimentary canal, which grows to and becomes connected with the chorion. In the human embryo, however, the allantois appears, from the researches of His, not to arise as an outgrowth from the alimentary canal at all, and, indeed, never to pass through the saccular stage shown in Figs. 22 and 23, but to be present from the very earliest period as a stalk connecting the hinder end of the embryo with the chorion.

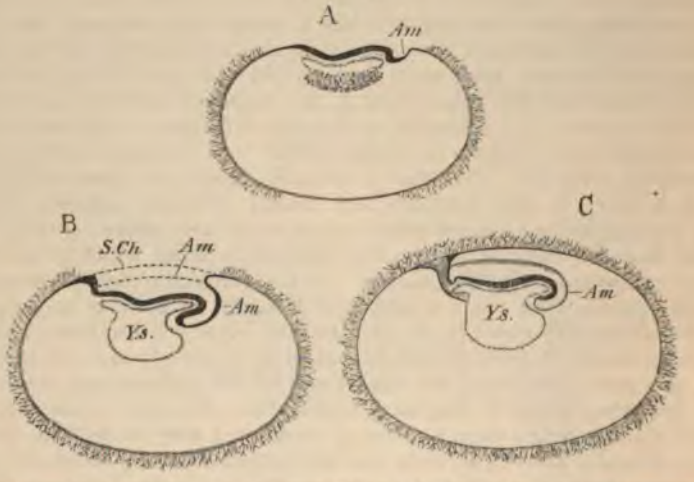
The following series of diagrams, copied from His, will make this clear, and will show how the stage now being considered may be derived, and probably is actually arrived at, from the stage represented by Reichert's ovum. The figures represent a series of diagrammatic longitudinal sections through ova at successive stages of development. Fig. 26, as we have seen, represents Reichert's ovum, with the exception that the layer of mesoblast, which is undoubtedly present as an inner lining to the wall of the vesicle, is omitted. In Fig. 28, A, the commencement of the formation of the embryo is indicated; the germinal area has become somewhat depressed, but at its anterior end (to the right in the figure) is lifted up slightly by a constriction—the head-fold. In Fig. 28, B, this head-fold has deepened, and the head-end of the embryo is now distinctly raised above the yolk-sac *Y.s.*; at the *hinder end of the embryo the germinal area, however, still preserves*, as in the former figure, *its primitive connection with the chorion*. In Fig. 28, C, the embryo has reached the stage shown in Fig. 27; indeed, Fig. 28, C, is a diagrammatic longitudinal section through this very embryo. At the hinder end of the embryo the tail-fold has now just commenced; but this does not interfere with the stalk —the allantoic stalk—which still connects directly together the embryo and the chorion.

If this view is correct, it is clear that in the human embryo the allantois is formed unusually early, and in an altogether exceptional manner. We may clearly connect this "precocious" development of the allantois with the "precocious" appearance of the vascular layer of mesoblast lining the blastodermic vesicle in the stage represented by Reichert's ovum; and we

may perhaps regard both features, in so far as they are exceptional, as examples of the tendency to abbreviation or shortening of the processes of development, which is a feature so constantly encountered by the student of embryology. The establishment of a vascular connection between the embryo and the chorion, and so indirectly with the mother, is as we have seen *the* characteristic feature of mammalian development, and, therefore, we need not wonder at finding in the most highly developed of all mammals this feature thrown back to an earlier stage than that at which it originally appeared, and hurried on prematurely, even at the expense (as it would seem) of the embryo itself, whose development is unusually retarded.

The series of figures given above indicate also the supposed stages in the development of the amnion, the sole peculiarity in which is that the head-fold—always the most prominent portion—here forms, with the side folds,

FIG. 28.



DIAGRAMMATIC LONGITUDINAL SECTIONS THROUGH HUMAN OVA, REPRESENTING STAGES (HYPOTHETICAL) INTERMEDIATE BETWEEN REICHERT'S OVUM AND HIS'S EMBRYO E. (From His.) × 5.

A. Shows commencement of head-fold, and of amnion (*Am*). B. Rather later stage: the head-fold and amnion are more marked, as also is the yolk-sac (*Y.s*). The hinder end of the embryo is continuous with the chorion through the allantoic stalk. The dotted lines indicate, hypothetically, the subsequent growth of the amnion. C. A still later stage: equivalent to that of His's embryo E (*vide* Fig. 27). The amnion is completed, and the villi extend completely round the ovum.

the whole amnion, there being no tail-fold developed at all. After completion of the amnion, the villi, previously absent over the germinal area, extend all over the ovum, *cf.* Fig. 28, C.

Summarizing what we know about the processes of development in the first fortnight, it would appear probable that the ovum—fertilized in the upper part of the Fallopian tube—travels slowly down towards the uterus, which it reaches about the eighth day. While in the tube it almost certainly undergoes segmentation in the usual mammalian manner, but does not increase greatly in size; according to Allen Thomson, "its diameter on arriving in the cavity of the uterus does not probably surpass one-hundredth (0.25 mm.), or at most one-eightieth of an inch." After entering the uterus it probably increases rapidly in size. It very early develops villi on its surface, and is completely enclosed in the *decidua reflexa* at any rate, by the

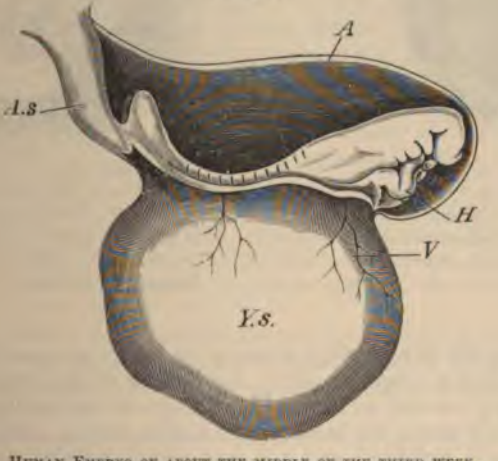
thirteenth day. In the development of the ovum the most noteworthy features appear to be the very early establishment of a lining of vascular mesoblast to the blastodermic vesicle, the very early appearance and peculiar mode of formation of the allantois, and the curiously late appearance of the embryo itself.

KRAUSE'S EMBRYO.—Concerning the allantois it ought to be mentioned here that a human embryo of a very much later stage than those we have just considered—*i. e.*, about the fourth week—has been described by Krause, in which there was no allantoic stalk connecting the embryo and chorion together, but the allantois hung down as a bag from the hinder end of the embryo, very much as shown in Fig. 22, 4. As this is at present an isolated exception to the general rule concerning the allantoic stalk in human embryos, it is perhaps permissible to regard it merely as an abnormality, in which case it may be viewed in the light of a reversion to the primitive mode of development of the allantois.

Third Week.—Of embryos belonging to the first half of the third week, only a very limited number have been accurately described and figured; but towards the close of the week specimens become far more abundant, and from this point onwards our knowledge of the development of the human embryo is in a tolerably satisfactory condition.

Fig. 29 shows the condition of the embryo at an age between the fifteenth and eighteenth days, as described and figured by Coste. The whole ovum

FIG. 29.



HUMAN EMBRYO OF ABOUT THE MIDDLE OF THE THIRD WEEK.
(From HIS, after COSTE.)

A. Amnion. *A.s.* Allantoic stalk. *H.* Heart. *V.* Bloodvessel of yolk-sac. *Y.s.* Yolk-sac.

measures 16.2 mm. along its greater diameter, and is covered exteriorly with short, slightly branched villi. The embryo is attached to the inner side of the chorion by the short allantoic stalk seen at the left-hand end of the figure, *A.s.* The embryo itself is 4.4 mm. in length; and is invested—not closely, but at some little distance—by the amnion. The head end of the embryo is completely raised above the yolk-sac, but the body is still so widely connected with the yolk-sac that one can hardly speak of a distinct yolk-stalk. The hinder end of the embryo is bent upwards rather strongly—a very characteristic feature of the early human embryo, and one which is

very probably to be ascribed, at any rate in great part, to the peculiarity already noticed concerning the allantois.

In the neck three thickenings—the visceral arches—are visible on each side, but the clefts between them have not yet been completed; below the neck, in the angle between the embryo and the yolk-sac, is the heart, a large tube twisted into an S shape. Bloodvessels are visible on the yolk-sac—which has a diameter of 2.75 mm.—and also in the allantoic stalk, whence they pass into the chorion, the inner layer of which is vascular all round the ovum, though the bloodvessels do not as yet pass into the villi.

The middle portion of the embryo is clearly divided into protovertebræ; but there are no traces whatever of limbs, or of either eyes or ears.

End of Third Week.—By the end of the third week or commencement of the fourth the embryo has undergone important changes. Figs. 30 and 31 show the whole ovum and the embryo at this age.

The whole ovum, which is shown of the natural size in Fig. 30, is somewhat pyriform, and measures 27 mm. along its greater diameter; it is covered all over with long branched villi. The embryo, which is represented on a larger scale in Fig. 31, has increased very considerably in size. It is no

Fig. 30.

Human Ovum at about the Commencement of the Fourth Week.

Part of the wall of the ovum has been removed to expose the embryo. (From Kölliker, after Allen Thomson). × 1.

Fig. 31.

The same Embryo as in Fig. 30, removed from the ovum, and magnified.

a. Amnion. *b*. Yolk-sac. *c*. Mandibular arch. *d*. Maxillary arch. *e*. Hyoidean arch; behind this are the first and second branchial arches. *f*. Rudiment of forelimb. *g*. Auditory vesicle. *h*. Eye. *i*. Heart. × 5.

longer straight, but is bent very strongly on itself—so much so, indeed, that it forms more than a complete circle, the flexure of the whole embryo being quite as strongly marked as in a rabbit embryo of the twelfth day (Fig. 21).

The yolk-sac is about the same size as before, having a diameter of 3 mm., but its surface is wrinkled, and it is now connected with the embryo by a very distinct stalk. The amnion is very closely applied to the embryo, and the allantoic stalk as before connects the embryo with the chorion.

In the embryo itself the most noteworthy features besides the strongly marked flexure are the following: There are indications of thirty-five protovertebræ, the greatest number ever present. Both pairs of limbs are present as short buds with very wide bases of origin, the arm and leg of either side being connected together by a low ridge, the Wolffian ridge, of which the limbs are merely special local developments. All the main divisions of the brain are present, and can be easily recognized, as can also the ganglia of several of the nerves. Five visceral arches are visible on each side—viz., the maxillary (forming the upper jaw), mandibular (forming the lower jaw), hyoidean, and first and second branchial arches. The optic vesicles are

present as outgrowths of the brain, but there is as yet no trace of the lens. The alimentary canal is a nearly straight tube, which communicates with the yolk-sac by only a very narrow channel.

The whole embryo measures about 4 mm. along its longest diameter, but, owing to the flexure of the body, its real length must be at least double this.

Fourth Week.—By the end of the fourth week the rudiments of all the more important organs have become definitely established, and the embryo has arrived at a very well-marked period of development. It has now reached a stage corresponding closely with that attained by the rabbit embryo about the twelfth day, and by a chick embryo towards the end of the fourth day of incubation.

We have already had occasion when considering the earliest stages of development to notice the extreme slowness with which the human embryo develops. This is very strikingly exemplified by the facts just stated—viz., that the human embryo takes four weeks to reach the same stage of development and complexity of organization, and, what is more, the same actual size, that a chick embryo accomplishes in exactly one-seventh of the time.

This is doubtless in part due to the fact that the chick embryo is exceptionally well off in having an enormous supply of food ready to hand in the shape of the yolk of the egg; while, on the other hand, the mammalian embryo has to devote part of its energies to the establishment, at as early a period as possible, of the placenta for the sake of obtaining nutriment from the mother. But although this may explain why the mammal develops more slowly than the chick, it does not in any way help us to understand why the human embryo develops during its early stages at less than half the rate of the rabbit, and we must be content for the present to accept as an unexplained fact that the human embryo does dawdle over its development in a manner as yet completely inexplicable.

As the stage we are now dealing with, the end of the fourth week, is an important one in many ways, and as our knowledge of it, owing to His's admirable investigations, is in a very satisfactory and fairly complete state, it will be well to describe it in some detail.

Figs. 32, 33, and 34 are different views of an embryo of this age. Fig. 32 shows the external appearance as seen from the right side; Fig. 33 is a longitudinal section to show the alimentary canal and parts in connection with it; while Fig. 34 is a diagrammatic representation of the principal blood-vessels *in situ*.

The embryo is bent on itself as shown in the figures, and is closely invested by the amnion; it is connected with the yolk-sac by a short but narrow stalk, and with the chorion by the wide allantoic stalk, now somewhat longer than it was before.

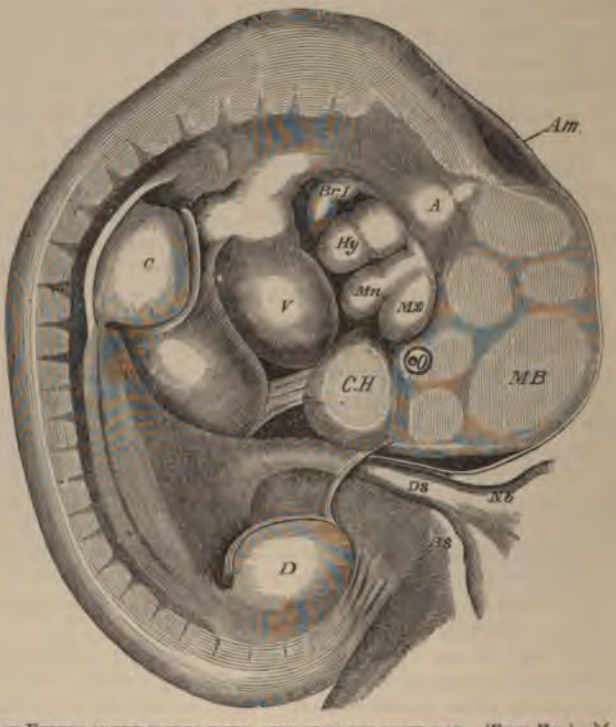
The body measures along its greatest diameter 7 mm., but if straightened out would be about 14 mm. in length. In the head the several divisions of the brain are clearly visible, as are also the visceral arches and clefts, and the eye and ear. In the body the full number of protovertebræ, thirty-five, is present; and the limbs are still short and very broad buds, whose bases extend over several segments. Immediately underneath the neck is seen the large prominence formed by the heart, and below this again a lesser one due to the liver.

The alimentary canal forms a continuous and but slightly twisted tube. The mouth, on the under surface of the head, opens into the buccal cavity, from which the pituitary diverticulum is given off towards the base of the midbrain, while in the floor of the hinder part is the rudimentary tongue. Behind this the buccal cavity passes into the pharynx, which opens to the exterior by two visceral clefts on each side. In the floor of the pharynx is a

slit-like opening, the glottis, leading into a short canal, the trachea, which bifurcates into two blind sacs, the rudiments of the lungs.

Behind the pharynx the alimentary canal is continued as a narrow tube, the œsophagus, with the lungs on either side of it. The œsophagus opens into a stomach which is but very slightly dilated, and is continued into the

FIG. 32.



HUMAN EMBRYO OF THE FOURTH WEEK, SEEN FROM THE RIGHT SIDE. (From His.) × 13.

A. Auditory vesicle. *Am*. Amnion. *Br.I*. First branchial arch. *Bs*. Allantoic stalk. *C*. Rudiment of arm. *C.H* Cerebral hemisphere. *D*. Rudiment of leg. *Ds*. Yolk-stalk. *Hy*. Hyoidean arch. *MB*. Mid-brain. *Ms*. Mandibular arch. *Mx*. Maxillary arch. *Nb*. Yolk-sac. *O*. Eye. *V*. Ventricular portion of heart.

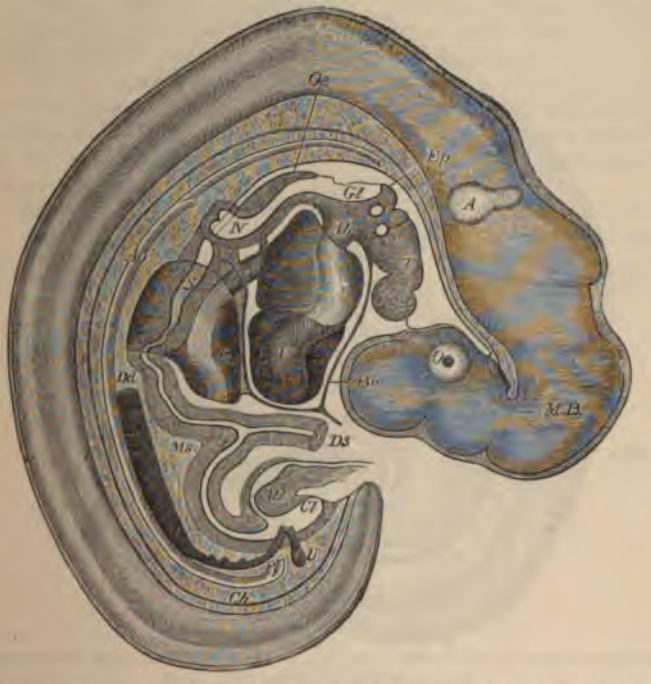
small intestine. This runs forward and (Fig. 33) joins the large intestine at a rather sharp angle. From this angle the cavity of the yolk-stalk, leading to the yolk-sac, arises. The large intestine is at first tubular, but after giving off the cavity of the allantois it expands to form a cloacal sac, which opens to the exterior at the anus: just before doing so it receives on its dorsal surface the openings of the Wolffian ducts, the ducts of the primitive kidneys. A slight dilatation near the commencement of the allantoic stalk is the rudiment of the future urinary bladder.

The liver is a large organ whose position has been already noticed; it opens by a short bile-duct into the intestine just below the stomach.

The vascular system, which is shown in Fig. 34, has attained very considerable complexity. The heart, which is of great size, lies between the head and the liver, and already exhibits all the principal divisions of the adult. It is bent on itself like a letter S, whereof the first or upper loop is the auricular portion of the heart; the second or lower loop, which is in very

close proximity to the cerebral hemisphere, is the ventricular part; and the terminal limb of the S is the aortic bulb which runs backwards (upwards in the figure) beneath the lower wall of the head. The auricular portion of the heart is very wide transversely; it is partially divided by a semilunar fold into right and left auricles, whereof the right auricle receives (1) venous blood brought from the body of the embryo by two large veins, the right and left *ductus cuvieri*, each of which is formed by the union of an anterior cardinal or jugular vein returning blood from the head, and a posterior cardinal vein coming from the hinder part of the body and chiefly from the Wolffian bodies or primitive kidneys; and (2) blood which is more arterial

FIG. 33.



DIAGRAMMATIC SECTION OF HUMAN EMBRYO AT THE END OF THE FOURTH WEEK, SHOWING THE ALIMENTARY CANAL AND PARTS IN RELATION WITH IT. (From His.) × 13.

A. Auditory vesicle. *Ab.* Truncus arteriosus. *All* Allantoic stalk. *Ao.* Aorta. *Br.* Ventral wall of thorax. *Ch.* Notochord. *Cl.* Cloaca. *Dd.* First part of small intestine, the future duodenum. *Ds.* Yolk-stalk, connecting intestine with yolk-sac. *Ep.* Epiglottis. *Gl.* Glottis. *L.* Liver. *M.B.* Midbrain. *Ms.* Mesentery. *N.* Right lung. *O.* Eye. *Oe.* Œsophagus. *S.* Stomach. *T.* Tongue. *U.* Ureter. *V.* Ventricle.

in character, brought back from the chorion by the umbilical or allantoic veins, and discharged into the right auricle by the *vena cava inferior*. The opening of the vena cava inferior into the right auricle is guarded by two prominent lips, the outer one of which is the Eustachian valve, which direct the blood from the inferior cava into the left auricle, which also receives the exceedingly small pulmonary veins.

The ventricular portion is partially divided into right and left ventricles by a septum incomplete above. The aortic bulb contains at present only a single tube, the cardiac aorta, into which both ventricles discharge; this runs back (up in the figure) to the hinder part of the floor of the buccal cavity,

and then gives off on each side a series of aortic arches which run up in the visceral arches, forming the side walls of the pharynx, and unite together above the pharynx to form the dorsal aorta, which runs back to the hinder end of the body. Of these aortic arches there are at first five on each side. The first and second aortic arches, lying in the mandibular and hyoidean arches respectively (Figs. 32 and 34) have already lost their primitive connections with the dorsal aorta, and together form the external carotid artery, the first arch representing its lingual branch.

The third aortic arch (Fig. 34, 3) forms the internal carotid artery, but is still connected with the dorsal aorta. The fourth arch (Fig. 34, 4) forms

FIG. 34.

DIAGRAMMATIC SECTION OF HUMAN EMBRYO AT THE END OF THE FOURTH WEEK, SHOWING THE HEART AND BLOODVESSELS. (From His.) × 13.

A. Auditory vesicle. *Ac.* Auditory nerve. *Ao.* Dorsal aorta. *Bs.* Allantoic stalk. *CH.* Cerebral hemisphere. *Ci.* Vena cava inferior. *Cl.* Cloaca. *Cs.* Vena cava superior. *Dr.* Small intestine. *Ds.* Yolk-stalk. *GG* Gasserian ganglion. *Gl.* Ganglion of glossopharyngeal nerve. *Hp.* Hypoglossal nerve. *L.* Liver. *MB* Midbrain. *Ms.* Mesentery. *O* Eye. *Sa.* Auricular septum. *Sc.* Ventricular septum. *T.* Tongue. *U.* Ureter. *Us.* Wolffian body, or primitive kidney. *Vg* Vagus, or pneumogastric nerve. *V.om.* Vitelline, or omphalomesenteric vein. 1. First aortic arch, forming lingual branch of external carotid artery. 2. Second aortic arch, forming external carotid artery. 3. Third aortic arch, forming internal carotid artery. 4. Fourth aortic arch, forming on left side the dorsal aorta. 5. Fifth aortic arch, forming the pulmonary artery.

the main portion, and later on the whole of the dorsal aorta; the arches of the two sides, right and left, are at this stage equal in size. The fifth arch (Fig. 34, 5) joins the dorsal aorta, but before doing so gives off a branch—the pulmonary artery—to the lung of its side.

The dorsal aorta, formed in this way by the third, fourth, and fifth aortic arches of each side, runs down the dorsal surface of the embryo, giving off small arteries to the alimentary canal and Wolffian bodies. About the level of the cloaca it divides into the two umbilical arteries which convey the

blood of the embryo along the allantoic stalk to the chorion, whence it returns charged with nutrient matter by the umbilical veins, and so passes by the inferior vena cava to the right auricle.

The vessels in connection with the yolk-sac are still present, but are of no great importance. The vein returning blood from the yolk-sac, after receiving the veins from the alimentary canal and thereby forming the portal vein, enters the liver, and there unites with the right umbilical vein coming from the chorion.

All the vessels are at present merely tubular channels in the tissue of the embryo, lined by endothelium, but with no proper connective tissue or muscular walls of their own.

Concerning the other organs of an embryo of this age, we may notice the following points: The Wolffian bodies or primitive kidneys (Fig. 34, *Un*) extend forwards as far as the lungs. Each consists of a series of short convoluted tubes, commencing with dilated Malpighian bodies, and opening at their other ends into the Wolffian duct. The two Wolffian ducts open separately into the cloaca, nearly opposite to the opening of the allantois. Of the permanent kidneys and ureters there is no trace, unless a small saccular dilatation on each Wolffian duct close to its opening into the cloaca be the commencement of the ureter (Fig. 34, *U*).

The large size of the head, due almost entirely to the brain, is a striking feature in nearly all vertebrate embryos of this age, though less marked in mammals than in some of the lower forms. In the human embryo the brain at this stage forms about one-third the total length of the embryo. Besides

FIG. 35.

HUMAN EMBRYO AT ABOUT THE END OF THE FIFTH WEEK. (From His.) × 5.

all the main divisions of the brain, the Gasserian ganglion on the fifth nerve, and the ganglionic swellings on the auditory, glossopharyngeal, and pneumogastric nerves are very evident (Fig. 34).

The olfactory organs are present as shallow pits on the under surface of the head, communicating by grooves—the rudiments of the posterior nares—with the mouth. The eyes are of very small size as compared with other vertebrate embryos; and the lens is still in the form of an open pit. The auditory organs (Figs. 32 and 34) are closed pear-shaped vesicles, situated just above the tops of the hyomandibular clefts—the rudiments of the future

and then gives off on each side a series of aortic arches which run up in the visceral arches, forming the side walls of the pharynx, and unite together above the pharynx to form the dorsal aorta, which runs back to the hinder end of the body. Of these aortic arches there are at first five on each side. The first and second aortic arches, lying in the mandibular and hyoidean arches respectively (Figs. 32 and 34) have already lost their primitive connections with the dorsal aorta, and together form the external carotid artery, the first arch representing its lingual branch.

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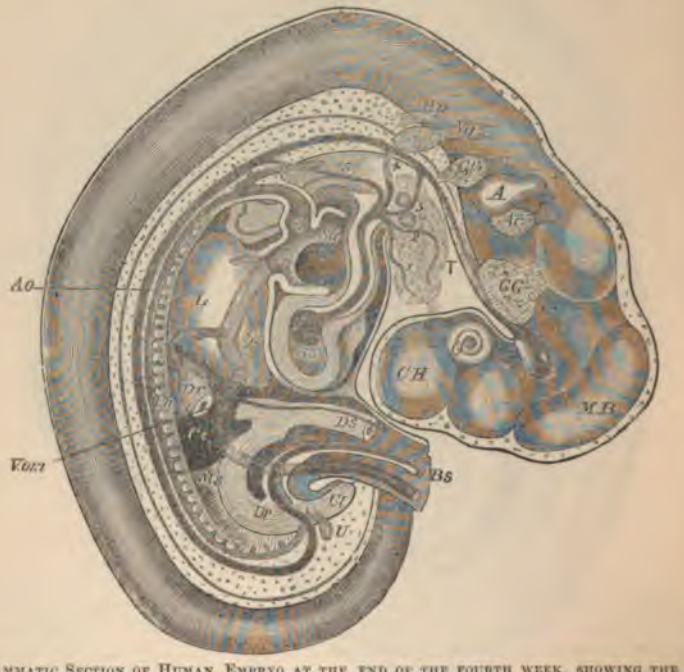
FIG. 34.



DIAGRAMMATIC SECTION OF HUMAN EMBRYO AT THE END OF THE FOURTH WEEK, SHOWING THE HEART AND BLOODVESSELS. (From His.) × 13.

A. Auditory vesicle. *Ac.* Auditory nerve. *Ao.* Dorsal aorta. *Bs.* Allantoic stalk. *CH.* Cerebral hemisphere. *Ci.* Vena cava inferior. *Cl.* Cloaca. *Cs.* Vena cava superior. *Dr.* Small intestine. *Ds.* Yolk-stalk. *GG* Gasserian ganglion. *Gl.* Ganglion of glossopharyngeal nerve. *Hp.* Hypoglossal nerve. *L* Liver. *MB* Midbrain. *Ms.* Mesentery. *O* Eye. *Sa.* Auricular septum. *Sc.* Ventricular septum. *T.* Tongue. *U* Ureter. *Un.* Wolffian body, or primitive kidney. *Vg* Vagus, or pneumogastric nerve. *V.om.* Vitelline, or omphalomesenteric vein. 1. First aortic arch, forming lingual branch of external carotid artery. 2. Second aortic arch, forming external carotid artery. 3. Third aortic arch, forming internal carotid artery. 4. Fourth aortic arch, forming on left side the dorsal aorta. 5. Fifth aortic arch, forming the pulmonary artery.

the main portion, and later on the whole of the dorsal aorta; the arches of the two sides, right and left, are at this stage equal in size. The fifth arch (Fig. 34, 5) joins the dorsal aorta, but before doing so gives off a branch—the pulmonary artery—to the lung of its side.

The dorsal aorta, formed in this way by the third, fourth, and fifth aortic arches of each side, runs down the dorsal surface of the embryo, giving off small arteries to the alimentary canal and Wolffian bodies. About the level of the cloaca it divides into the two umbilical arteries which conv-

blood of the embryo along the allantoic stalk to the chorion, whence it returns charged with nutrient matter by the umbilical veins, and so passes by the inferior vena cava to the right auricle.

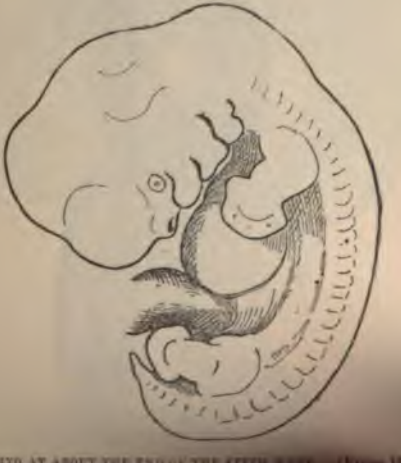
The vessels in connection with the yolk-sac are still present, but are of no great importance. The vein returning blood from the yolk-sac, after receiving the veins from the alimentary canal and thereby forming the portal vein, enters the liver, and there unites with the right umbilical vein coming from the chorion.

All the vessels are at present merely tubular channels in the tissue of the embryo, lined by endothelium, but with no proper connective tissue or muscular walls of their own.

Concerning the other organs of an embryo of this age, we may notice the following points: The Wolffian bodies or primitive kidneys (Fig. 34, *Un*) extend forwards as far as the lungs. Each consists of a series of short convoluted tubes, commencing with dilated Malpighian bodies, and opening at their other ends into the Wolffian duct. The two Wolffian ducts open separately into the cloaca, nearly opposite to the opening of the allantois. Of the permanent kidneys and ureters there is no trace, unless a small saccular dilatation on each Wolffian duct close to its opening into the cloaca be the commencement of the ureter (Fig. 34, *U*).

The large size of the head, due almost entirely to the brain, is a striking feature in nearly all vertebrate embryos of this age, though less marked in mammals than in some of the lower forms. In the human embryo the brain at this stage forms about one-third the total length of the embryo. Besides

FIG. 35.



HUMAN EMBRYO AT ABOUT THE END OF THE FIFTH WEEK. (From His.) ×

all the main divisions of the brain, the [illegible] fifth nerve, and the ganglionic swellings on [illegible], and pneumogastric nerves are very evident.

The olfactory organs are present [illegible] surface of the head, communicating by [illegible] nares—with the mouth. The eyes [illegible] with other vertebrate embryos; and the [illegible] pit. The auditory organs (Figs. [illegible]) [illegible] cles, situated just above the tops [illegible] of the future

tympano-Eustachian passages—but having as yet no connection with them; rudiments of the aqueductus vestibuli, semicircular canals, and cochlea are present as slight outgrowths from each vesicle.

Finally, we may direct attention to the presence of a very rudimentary diaphragm between the heart and liver, and to the short, stumpy tail, in which the number of vertebræ is never greater than that present in the coccyx of the adult.

Fifth Week.—The rudiments of all the more important organs being already definitely established, there will be no occasion to describe the later

FIG. 36.

HUMAN EMBRYO OF THE THIRTY-FIFTH DAY, SEEN FROM THE VENTRAL SURFACE, AND PARTIALLY DISSECTED. (From KÖLLIKER, after COSTE.) × 5.

3. Left external nasal process. 4. Maxillary arch. 5. Mandibular arch. 8. Tail. 9. Arm. 9′. Leg. *a*. Right vitelline artery. *ae*. Lungs. *b*. Aortic bulb. *b′*. First persistent aortic arch, the carotid arch. *b″*. Second persistent aortic arch, the systemic arch. *b‴*. Third, or pulmonary arch. *c*. Right vena cava superior. *c′*. Venous sinus of heart. *e*. Stomach. *i*. Rectum. *j*. Left vitelline vein. *m*. Wolffian body. *n*. Umbilical or allantoic artery. *o′*. Left auricle. *s*. Portal vein. *u*. Umbilical vein. *v*. Right ventricle. *v′*. Left ventricle. *x*. Yolk-stalk. *z*. Tongue.

embryos in detail; but it will suffice to state the leading features of each of the well-marked periods of development, and to give brief accounts of the formation of some of the more important organs up to the time of birth.

At the end of the fifth week the embryo measures about 10 mm. in length, and weighs about 1 grm. Its external appearance is shown in Fig. 35, and the leading features of its anatomy in Fig. 36.

In this latter figure the embryo is represented from the ventral side, and is partially dissected, the liver being completely removed. The chief features in which it differs from the embryo of the fourth week are the following: The whole body is not nearly so strongly flexed, but has begun to straighten out. The limbs are considerably larger, and already show signs of division into their several segments. The gill clefts, with the exception of the hyomandibular cleft, have completely closed up, and the face is more fully formed than before. The yolk-sac is small, and is connected with the embryo by a long slender stalk. The allantoic stalk is still short and thick. The amnion, instead of closely investing the embryo, is now at some distance from it, and is very nearly in contact with the chorion. The villi of the chorion are very large and branched, and still extend over the whole surface of the ovum, though they are rather larger opposite the spot where the ovum is directly attached to the uterus—*i. e.*, the *decidua serotina*, the site of the future placenta—than they are elsewhere.

Of the internal organs of the embryo, the stomach is now a more conspicuous dilatation than before; while the small intestine has elongated so

FIG. 37.

PREGNANT UTERUS OF ABOUT THE FORTIETH DAY. (From KÖLLIKER, after COSTE.) × ½.

The uterus has been opened from in front, and the *decidua reflexa* has also been cut through and the flaps turned aside to expose the ovum. The chorion has been laid open by a crucial incision, and the flaps turned aside to show the embryo invested by the amnion, and with the small yolk-sac lying between the amnion and chorion. At the upper part of the figure the apertures of the Fallopian tubes are seen.

as to form a loop, from the apex of which the slender yolk-stalk still arises; lower down, at the junction of small and large intestines, a rudiment of the cæcum has appeared. The lungs, liver, and heart have all increased in size, while the right umbilical vein, which has been all along the smaller of the two veins returning blood from the allantois to the embryo, has disappeared. The Wolffian bodies are rather shorter than before, and along their

inner borders two slight thickenings of the peritoneal epithelium—the genital ridges—have appeared. There are also present two new ducts, the Müllerian ducts, which will become in the female child the oviducts or Fallopian tubes, and the uterus and vagina.

Sixth Week.—The embryo has grown considerably, and is now from 15 to 20 mm. in length. It is shown *in situ* in Fig. 37; while Fig. 38 is a profile view on a larger scale.

Fig. 37 shows us that the amnion is now a considerable distance from the embryo, and has indeed nearly reached the chorion; that the allantoic stalk is still short and thick; that the yolk-stalk is long and slender, its proximal portion being bound up with the allantoic stalk in the sheath formed round both by the amnion (*cf.* Fig. 22, 5), while its distal portion, ending in the small yolk-sac, lies between the amnion and chorion (*cf.* Figs. 22 and 45). The limbs are larger, and show at their extremities rudiments of the fingers

FIG. 38.

HUMAN EMBRYO OF ABOUT THE SIXTH WEEK. (FROM HIS.) × 5.

and toes. The mouth is still very wide; a slight prominence above it marks the commencement of the nose, and the margin of the hyomandibular cleft forms a slightly projecting ring, the external ear.

Of the internal organs the alimentary canal has increased in length, and the cæcum is now very evident; the Wolffian bodies are somewhat smaller than before, while the genital organs have increased in size, and the permanent kidneys and ureters have become definitely established. Finally, by the end of the sixth or commencement of the seventh week, ossification commences in the clavicle, and very shortly afterwards in the lower jaw.

Second Month.—At the end of the second month the embryo measures from 30 to 40 mm. in length, and weighs 12 to 20 grms. The head is very large, and forms at least a third of the whole embryo. The nose is rather more prominent, but is still very small; slight folds of skin round the mouth and eyes mark the commencements of the lips and eyelids. The external

blood of the embryo along the allantoic stalk to the chorion, whence it returns charged with nutrient matter by the umbilical veins, and so passes by the inferior vena cava to the right auricle.

The vessels in connection with the yolk-sac are still present, but are of no great importance. The vein returning blood from the yolk-sac, after receiving the veins from the alimentary canal and thereby forming the portal vein, enters the liver, and there unites with the right umbilical vein coming from the chorion.

All the vessels are at present merely tubular channels in the tissue of the embryo, lined by endothelium, but with no proper connective tissue or muscular walls of their own.

Concerning the other organs of an embryo of this age, we may notice the following points: The Wolffian bodies or primitive kidneys (Fig. 34, *Un*) extend forwards as far as the lungs. Each consists of a series of short convoluted tubes, commencing with dilated Malpighian bodies, and opening at their other ends into the Wolffian duct. The two Wolffian ducts open separately into the cloaca, nearly opposite to the opening of the allantois. Of the permanent kidneys and ureters there is no trace, unless a small saccular dilatation on each Wolffian duct close to its opening into the cloaca be the commencement of the ureter (Fig. 34, *U*).

The large size of the head, due almost entirely to the brain, is a striking feature in nearly all vertebrate embryos of this age, though less marked in mammals than in some of the lower forms. In the human embryo the brain at this stage forms about one-third the total length of the embryo. Besides

FIG. 35.

HUMAN EMBRYO AT ABOUT THE END OF THE FIFTH WEEK. (From His.) × 5.

all the main divisions of the brain, the Gasserian ganglion on the fifth nerve, and the ganglionic swellings on the auditory, glossopharyngeal, and pneumogastric nerves are very evident (Fig. 34).

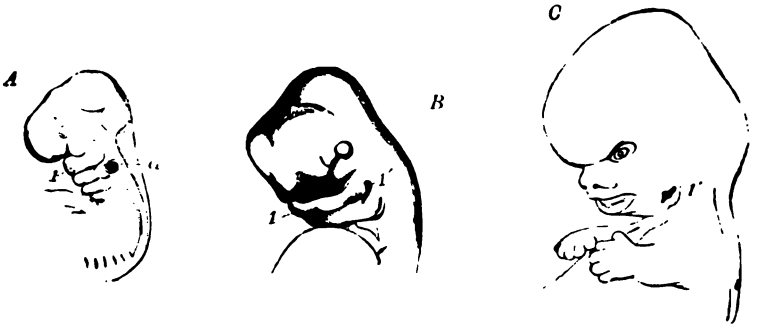
The olfactory organs are present as shallow pits on the under surface of the head, communicating by grooves—the rudiments of the posterior nares—with the mouth. The eyes are of very small size as compared with other vertebrate embryos; and the lens is still in the form of an open pit. The auditory organs (Figs. 32 and 34) are closed pear-shaped vesicles, situated just above the tops of the hyomandibular clefts—the rudiments of the future

TENTH WEEK.—The embryo has now a length of 4 to 6 cm., and weighs 45 to 48 grms. The limbs are still short, but their several divisions are far more evident than before, and rudiments of the nails have commenced to appear as small tubercles.

The ventral wall of the body is far more completely formed than heretofore. The umbilical stalk, formed, it will be remembered, of allantoic stalk and yolk-stalk bound together and ensheathed by the amnion, has grown considerably; it is now longer than the embryo, and is twisted on itself in a spiral manner; it still contains at its base a loop of intestine.

The face has developed considerably, and all the features are now definitely established; the eyelids are present; there is a distinct though very flat nose, definite lips, and well-developed external ears. In Fig. 40 the leading stages in the development of the face are shown. At the sixth week, B, the mouth opening is still very wide; it is bounded in front by the median fronto-nasal process, at the sides by the maxillary arches, and behind by the mandibular

FIG. 40.



FIGURES ILLUSTRATING THE FORMATION OF THE FACE IN THE HUMAN EMBRYO.
(From QUAIN'S *Anatomy*.)

A.—Head of an embryo of about four weeks. (After ALLEN THOMSON.) 1. Mandibular arch. *a*. Ear.
B.—Head of an embryo of about six weeks. (After ECKER.) 1. Mandibular arch. 1'. Hyomandibular cleft.
C.—Head of an embryo of about nine weeks. (After ECKER.)

arches, which meet one another in the middle line at the site of the future chin. By the eighth or ninth week, C, the maxillary processes have grown in towards one another so as to reduce the width of the mouth, and have fused with the fronto-nasal process to complete the upper jaw. The nose is an outgrowth from the fronto-nasal process; folds of integument give rise to the eyelids and lips, while another fold arising behind the hyomandibular cleft forms the external ear.

Third Month.—At the end of the third month the embryo, which from this time is commonly spoken of as the fœtus, is from 13 to 15 cm. in length, and weighs 100 to 125 grms. The head is still very large relatively to the rest of the body, but not nearly so much so as in the earlier stages. Both mouth and eyes are closed. The neck, already present at the eighth or ninth week, is now far more evident, and the limbs, though still small, have acquired their definite shapes and proportions; the nails are present as very thin plates. The integument is slightly firmer than before, but is still very thin, transparent, and rose-colored. Hitherto part of the alimentary canal has been situated in the allantoic stalk, and therefore outside the embryo (Fig. 33), but by the end of the third month this is withdrawn, and the whole alimentary canal, which has increased greatly in length, is thenceforward situated entirely within the abdominal cavity.

NERVOUS SYSTEM.—The cerebral hemispheres are large, but do not yet cover the midbrain, which latter is smooth and presents no trace of its subsequently acquired division into the *corpora quadrigemina*. The cerebellum is a broad transverse band; the fourth ventricle is a large cavity with a very thin roof; and the spinal cord presents well-marked brachial and lumbar enlargements.

URINO-GENITAL ORGANS.—By the end of the third month very important changes have been effected in the mutual relations of the rectum, bladder, and urinary and genital ducts—changes which result in the establishment of the external generative organs and in the external differentiation of the sexes. Though these changes commenced at an earlier period than that with which we are now dealing, it has been convenient to postpone their description until we were in a position to deal with them in their entirety.

The condition of the parts with which we are concerned about the end of the fourth week is shown in Figs. 33 and 34. The terminal portion of the intestine is dilated to form the cloaca, *Cl*. Into the cloaca open—(1) on the ventral surface, the cavity of the allantois, *All*, which later on becomes the bladder; (2) on the dorsal surface, nearly opposite the aperture of the bladder, the two Wolffian ducts, coming from the Wolffian bodies or primitive kidneys.

By the end of the fifth week the following changes have occurred: (1) the essential organs of reproduction have appeared as a pair of longitudinal ridges lying along the inner sides of the Wolffian bodies (Fig. 36); (2) a pair of new ducts, the Müllerian ducts, have appeared, which open in front into the body-cavity, and unite together posteriorly to open into the neck of the bladder just before it opens into the cloaca; and (3) the Wolffian ducts have shifted so as to open into the neck of the bladder with the Müllerian ducts, and so only indirectly into the cloaca.

During the sixth week the permanent kidneys and ureters appear. The exact mode of their development in man is not known, but it is probable from analogy that the ureters are formed as outgrowths from the dorsal surface of the Wolffian ducts, in which case it is very possible that the saccular outgrowths seen in this position at the end of the fourth week (*vide* Fig. 34, *U*) are their first rudiments. The kidneys are probably formed from two masses of tissue immediately behind the Wolffian bodies and directly continuous with them. The ureters very early acquire independent openings into the bladder, rather higher up than the openings of the Wolffian and Müllerian ducts. From this period up to the ninth week the changes are comparatively unimportant.

By the ninth week the essential reproductive organs have increased greatly in size; while the neck of the bladder has elongated considerably to form a *sinus urinogenitalis*. The two ureters open directly into the bladder, and the Wolffian and Müllerian ducts into the *sinus urinogenitalis* some distance below the ureters. Owing to the development of a median septum the *sinus urinogenitalis* and the rectum are almost completely separated from one another; they still, however, open to the exterior by a common cloacal orifice, though the cloaca itself is now a very shallow chamber.

Immediately in front of the cloacal aperture is a small conical prominence, which, inasmuch as it becomes in the female the clitoris and in the male the penis, we may speak of as *clitoro penis* (Fig. 41); on its posterior surface is a groove continued into the urino-genital sinus; and on either side of it are prominent folds of skin, *h l*, which we may call *labio-scrotal* folds.

A very little later, in the course of the tenth week, the septum between the urino-genital sinus and the rectum grows downwards so as to reach the surface. We now have no longer a cloaca, but two perfectly distinct

apertures (Fig. 42, *a* and *e*), whereof the anterior is the urino-genital and the posterior the anus.

Up to this time the changes are the same in all embryos, but about the end of the tenth week external sexual differences become apparent. In female embryos (Fig. 43) the conical eminence remains small, and becomes the clitoris; the folds of skin surrounding it become the *mons veneris* in

FIG. 41.

EXTERNAL GENITALIA OF A HUMAN EMBRYO OF ABOUT THE NINTH WEEK. (From KÖLLIKER, after ECKER.) × 2.

e. Clitoro-penis. *f*. Groove continuous with urino-genital sinus. *hl*. Labio-scrotal folds. *n*. Umbilical cord. *s*. Coccygeal region.

FIG. 42.

EXTERNAL GENITALIA OF A HUMAN EMBRYO OF ABOUT THE TENTH WEEK. (From KÖLLIKER, after ECKER.) × 2.

a. Anus. *e*. Clitoro-penis. *f*. Urino-genital aperture. *hl*. Labio-scrotal folds. *s*. Coccygeal region.

front and the *labia majora* at the sides, while the smaller folds bounding the urino-genital orifice become the *labia minora* or *nymphæ;* the urino-genital canal shortens considerably, so as to bring the aperture of the urethra very close to the surface.

In male embryos (Fig. 44) the conical eminence elongates and becomes the *penis*, the groove on its posterior surface closing to form the canal of the penis

FIG. 43.

FIG. 44.

EXTERNAL GENITALIA OF HUMAN EMBRYOS TOWARDS THE END OF THE THIRD MONTH. (From KÖLLIKER, after ECKER.)

Fig. 43.—(*Female.*) *a*. Anus. *e* Clitoris. *f*. Urino-genital aperture. *hl*. Labia majora. *n*. Labia minora, or lips of urino-genital aperture. *s* Coccygeal region.

Fig. 44.—(*Male.*) *a*. Anus. *e*. Penis. *f*, *r*. Lips of genital cleft fused together. *hl*. Scrotum. *s*. Coccyx.

or penial urethra; the folds of skin similarly unite together in the middle line behind the penis and so form the *scrotum*.

The above changes are usually effected, and the organs mentioned definitely established by the end of the third month, but the processes may be delayed till later.

Concerning the essential organs of reproduction and their ducts there is yet something to be said. The ovary and testis are at first absolutely indistinguishable from one another, and it is not until about the eighth week that characteristic differences appear between them. In both sexes there is a very close relation between the essential reproductive organs and the Wolffian bodies, which latter, as was noticed in the chapter on the ovary, send off out-

growths from their Malpighian bodies, forming the so-called "tubuliferous tissue," which lies very close beneath the germinal epithelium.

In the female the "tubuliferous tissue" gradually gets separated by connective tissue from the germinal epithelium; the Wolffian body shrinks considerably, and becomes converted into the *parovarium* or *epoophoron*, called also the organ of Rosenmüller (*vide* Fig. 12). The Wolffian duct is usually only recognizable in its upper portion, where it forms part of the parovarium; in ruminants, and sometimes in woman, its middle and lower portions persist as the *duct of Gaertner*, running in the broad ligament to the uterus. The Müllerian ducts become in their upper portions the Fallopian tubes, and in their lower portions unite to form the uterus and vagina. The fusion of the two ducts proceeds from below upwards, and, if it fail to extend as high as usual, may give rise to a double uterus, or even double vagina as well.

In the male the "tubuliferous tissue" becomes directly continuous with the seminal canals of the testis, forming by so doing the efferent canals for the passage of the spermatozoa to the exterior, the Wolffian body and duct becoming converted into the *epididymis* and *vas deferens* respectively.

The Müllerian ducts in the male are of no physiological importance; their lower united portions form the *vesicula prostatica* or *uterus masculinus;* the middle portions usually disappear, and the upper parts may either disappear or else persist in the neighborhood of the epididymis, and give rise to the "hydatids of Morgagni."

The Lungs.—The lungs make their first appearance as a hollow median diverticulum of the ventral wall of the œsophagus, just behind the gill clefts; the diverticulum consisting of an outer thicker wall of mesoblast, and an inner thinner lining of hypoblast, continuous with that of the alimentary canal.

The diverticulum very soon gives off two lateral outgrowths from its blind end, and so becomes bifid. Its condition at the end of the fourth week is well shown in Fig. 33. Later on, the mesoblast thickens considerably, and becomes riddled by a number of tubular outgrowths of the hypoblastic lining. These outgrowths become ultimately the bronchi, while their blind ends dilate to form the air-cells, which lie at first close to the surface and so give it a granular or tubercular appearance.

The original opening of the diverticulum into the œsophagus becomes modified to form the glottis, while the median portion of the diverticulum lengthens and becomes the trachea.

Fourth Month.—At the end of the fourth month the fœtus measures from 16 to 20 cm. in length, and weighs from 230 to 260 grms. The skin is of a rosy color, and is much firmer than before. Short whitish hairs appear on the head, and a slight down on other parts of the body. The eyes, nostrils, and mouth are all closed. The chin, which has hitherto been very inconspicuous, begins to become prominent. The legs and arms are of about equal length. The external sexual characters are usually well marked. The anus is open, and the duodenum contains meconium of a light grayish-white color. The umbilicus, or point of origin of the umbilical cord, is low down, close to the pubes. In the skull the bones are still far from meeting one another, so that the sutures and fontanelles are very wide. The muscles are more fully developed, and may give rise to distinct movements of the fœtus. In abortions at this period the fœtus may live for some hours.

Fifth Month.—Length of body, 20 to 27 cm.; weight, 250 to 350 grm. From this time onwards, according to Casper, the length of the fœtus affords a ready and easily remembered means of determining roughly its age; for from the fifth month to the end of pregnancy the length of the body in

inches is approximately double the number of lunar months the fœtus has lived. Thus, at the fifth month the length is 10 inches, at the sixth month 12 inches, and so on. The weight is subject to far greater variations than the length, and consequently affords a far less trustworthy criterion of age.

The skin is more consistent than before, and presents on its surface at certain places small patches of sebaceous matter. Hairs are more extensively developed, but are still devoid of any distinct color. . The legs are now longer than the arms, and the nails are well formed. The umbilicus is further forward than at the preceding month, and is now some distance above the pubes.

The head is still very large in proportion to the other parts. The heart, liver, and kidneys are also disproportionately large. The small intestine contains meconium, which is now, owing to the secretion of bile, of a pale greenish-yellow color. The gall-bladder is distinct.

Ossification has commenced in the pubes and in the os calcis.

Sixth Month.—The length, according to Cazeaux, varies from 28 to 32 cm.; the average length, according to Casper's calculation, is 12 inches, or 30 cm. The weight is much more variable; its average amount is stated by Cazeaux to be half a kilogramme.

The skin is of a dirty reddish color and much wrinkled. It is covered, at any rate in the axillæ and groins, with a sebaceous deposit. The hairs are more strongly developed and of a darker color than before. Both eyelashes and eyebrows have commenced to appear.

A complete pupillary membrane is commonly said to be present; but there seems to be some doubt on this point, and according to Velpeau and Cazeaux a large pupillary aperture is already present in the iris. Indeed, Velpeau contends that no pupillary membrane is ever present in the human embryo.

The umbilicus is still further forward than before. The meconium is much darker and more viscous than before. The testes of the male have not yet descended into the scrotum, but are found within the abdominal cavity, lying on the psoas muscles and immediately below the kidneys.

The sternum is well developed and has commenced to ossify. The nails reach to the ends of the fingers, and extend about a quarter of the way round them.

Seventh Month.—At the end of the seventh month the fœtus has a length of from 32 to 36 cm., and weighs on an average about 1 kilo.

The skin is still of a dirty reddish color, but is not so dark as it has hitherto been. There is an increased deposit of fat in the cellular tissue, causing the body to appear more plump and round. The hairs are plentiful and about a quarter of an inch (6 mm.) in length.

The several bones forming the roof of the skull become strongly convex, the central portion of each, whence ossification starts, forming a very evident prominence. The eyelids, which have been closed since reaching their full size in the fourth month, now open.

The whole of the large intestine is filled with a dark olive-green viscous meconium. The liver is still very large relatively to the whole body, and is of a deep brownish-red color.

The testes have, as a rule, descended as far as the inguinal ring, and may even have entered the inguinal canal.

The end of the seventh month is of interest as being perhaps the earliest period at which the fœtus can be born with any reasonable chance of surviving.

Eighth Month.—During the eighth month the increase in bulk is far more marked than that in length. At the end of the month the fœtus measures from 40 to 45 cm. in length, and weighs as much as 2 to 2½ kilos.

The skin is of a brighter flesh color than before, and is covered all over

with the sebaceous deposit known as "vernix caseosa." This substance, which usually makes its first appearance about the middle of gestation, was formerly considered to be a deposit formed from the liquor amnii, but appears rather to consist of matter formed by the cutaneous glands of the fœtus, mixed with dead epithelium cells. It varies much in quantity in different cases, and is always more abundant in certain situations, notably the head, axillæ, and groins.

The chin is now far more prominent than before, the lower jaw equalling the upper in length. The pupillary membranes, if ever present, are at any rate absent now. One of the testes, usually the left one, has passed through the inguinal canal into the scrotum, while the other one is still in the canal as a rule. There is no ossification in the lower epiphysis of the femur.

Ninth Month.—At the full time the fœtus is 50 to 60 cm. long, and weighs on the average 3 to 3½ kilos.

The skin is paler than before. The cellular tissue is filled with fat, giving roundness and firmness to the body and limbs. The hair is thick, long, fairly abundant as a rule on the head, while the down has begun to disappear from the body.

The umbilicus, formerly supposed to mark the exact middle of the body at full time, is stated by Cazeaux, on the authority of Moreau and Ollivier, to be on the average as much as 23 mm. below the middle point.

Both testes are as a rule in the scrotum, which has now a corrugated surface.

Ossification has commenced in the centre of the cartilage at the lower end of the femur. This is the first epiphyseal ossification to appear in the body, and is the only one present at the end of the ninth month. Its presence appears to be very constant at this period, and it has therefore received much attention as a ready and apparently reliable test of a fœtus having reached its full time.

CHAPTER V.

THE PLACENTA—PHYSIOLOGY OF THE FŒTUS.

The Fœtal Membranes.—The youngest stage in the development of the human ovum that has yet been found in the uterus is, as we have seen, that described by Reichert, and figured on page 82. This ovum, estimated to be thirteen days old, was already completely invested in a *decidua reflexa*. Its outer wall was described by Reichert as consisting of a single layer of epithelial cells, a description accepted also by His; but we have seen above that there is hardly any doubt that the wall is not of so simple a structure, but that immediately under the epithelial layer there is an inner vascular layer. As the vessels in this layer can be traced at a rather later stage into continuity with the umbilical vessels of the fœtus, there is little room for doubt that this inner vascular layer is really the allantois, developed very early relatively to the other organs, and in a very unusual manner.

The Chorion.—Such being the case, we may speak of the outer wall of Reichert's ovum as a *chorion*. A typical chorion, as we have seen in Chapter III., consists of three originally separate and distinct membranes fused together to form a single one—(1) on the outside the vitelline membrane, or zona pellucida; (2) within this the subzonal membrane, or false amnion; (3) within this again, the allantois. In the chorion of the early human ovum the zona pellucida does not appear to be recognizable; the epithelial layer may possibly be in part the equivalent of the subzonal membrane; while the inner vascular layer is almost certainly the allantois.

Reichert's ovum is surrounded by a broad marginal zone of villi, the centres of the two flattened surfaces forming bare patches. A short time later, towards the end of the third week, the villi extend so as completely to surround the ovum; they consist at first merely of epithelial cells derived from the outer layer of the chorion; but in the course of the fourth week, according to Coste, outgrowths from the vascular layer of the chorion enter the villi, each of which now consists of an external epithelial covering and a central connective tissue vascular core, the vessels of which are continuous with the umbilical vessels of the embryo.

From the fourth week up to the end of the second month, the chorion grows rapidly; the villi also increase very greatly, both in number and in size; they give off numerous branches which embed themselves in the decidua and end in free thread-like or frequently clavate processes, the so-called "roots." As in their first appearance, so also during the later stages of their growth, the epithelial layer is always in advance of the connective tissue core, the villi presenting lateral processes or knobs caused by local thickenings of the epithelium, into which, later on, the vascular tissue penetrates.

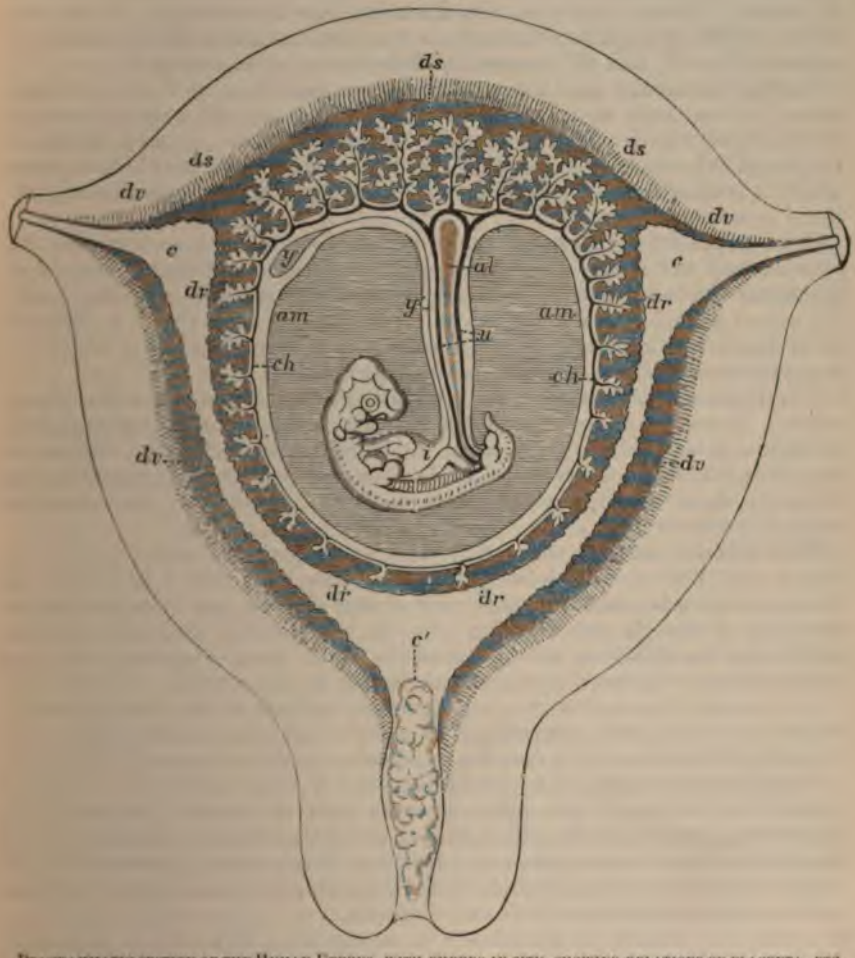
In the course of the third month, those villi which are in connection with the *decidua reflexa* begin to shrink, the bloodvessels of the part of the chorion from which they spring undergoing at the same time a gradual diminution in size. The villi that are embedded in the *decidua serotina*, on the other hand, increase greatly in size and complexity, and ultimately form, as we shall see, the fœtal part of the placenta (*cf.* the diagrammatic figure 45).

In this way we get a distinction established between the *chorion frondosum*,

opposite the *decidua serotina*, which is very vascular, and beset with closely placed and richly branched villi; and the *chorion lævе*, opposite the *decidua reflexa*, which is a thin transparent membrane with no bloodvessels, and connected with the *reflexa* by scattered, slightly branched, inconspicuous villi.

Up to the end of the third month the villi can be readily withdrawn from

FIG. 45.



DIAGRAMMATIC SECTION OF THE HUMAN UTERUS, WITH EMBRYO IN SITU, SHOWING RELATIONS OF PLACENTA, ETC. (From QUAIN'S *Anatomy*.)

al. Allantoic stalk. *am*. True amnion; the part shaded horizontally, between the amnion and the embryo, is the amniotic cavity. *c*. Cavity of uterus. *c'*. Plug of mucus in cervix uteri. *ch*. Chorion. *dr*. Decidua reflexa *ds* Decidua serotina. *dr*. Decidua vera. *i*. Intestine of embryo. *u*. Umbilical or allantoic arteries. *y*. Yolk-sac. *y'*. Yolk-stalk.

the crypts of the *decidua* in which they are lodged, and the fœtal and maternal structures separated from one another; but after the placenta is once established, the connection between fœtal and maternal elements becomes so intimate that complete separation is no longer practicable.

The Amnion.—The amnion, like the allantois, appears to develop in the human species in a somewhat aberrant manner, though it is very possible that further investigations will remove many of the apparent anomalies in its mode of origin. What is known of its early stages has already been explained in the preceding chapter.

The true amnion, with which alone we are now concerned, completely covers the dorsal surface of the embryo as early as the fourteenth day (*cf.* Fig. 27). Its condition at the middle of the third week is shown in Fig. 29, where it is seen to be some distance away from the embryo. At the end of the fourth week, as at the corresponding stage of the rabbit or chick, the amnion (Figs. 31 and 32) invests the embryo very closely indeed.

During the second month the amnion grows rapidly, so as to leave a large space (the amnionic cavity) between itself and the embryo, a space occupied by the *liquor amnii*. The amnion, by its further growth, forms a sheath to the umbilical cord, and comes in very close contact with the chorion, from which it is usually separated by a small quantity of fluid, or else by a gelatinous *membrana intermedia*.

Liquor Amnii.—The *liquor amnii*, which occupies the space between the amnion and the embryo, varies much in quantity at different periods of gestation. It is apparently most abundant about the fifth or sixth month. Its actual quantity varies also so much in different cases that it is difficult to fix its normal amount. When in excess—*i. e.*, more than about 1½ litre—it constitutes the affection known as *hydrops amnii*.

The *liquor amnii* contains urea, especially during the later months of gestation. It was formerly regarded as a nutritive fluid, but the researches of Gusserow point strongly in favor of its being really excretory. Gusserow considers that in the early stages of development it is simply a transudation from the fœtal vessels, but that later on it receives directly the urine discharged by the fœtus.

The yolk-sac persists throughout the whole period of gestation; in the fourth and fifth months it is a roundish, white body from 7 to 11 mm. in diameter, lying between the amnion and the chorion, and usually close to the edge of the placenta (*cf.* Fig. 45). It is connected by a long, slender stalk with the umbilicus of the fœtus, the stalk being—together with the allantoic stalk—invested by the sheath formed by the amnion.

At the end of gestation the yolk-sac is still present in the same situation close to the edge of the placenta; it is rather smaller than before, measuring from 4 to 7 mm., and very commonly adheres closely to the amnion.

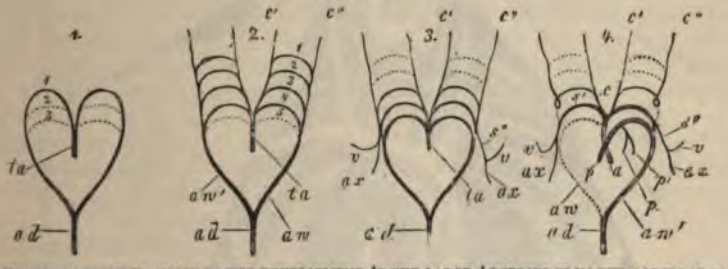
The Umbilical Cord.—The umbilical cord is composed of the following parts (Fig. 45): (1) The allantoic stalk with its vessels, the umbilical arteries and veins; (2) the yolk-stalk, and (3) the common investment formed round these two by the amnion. Its main, if not indeed its sole, function is to convey the umbilical vessels to the placenta, and so maintain the vascular connection between fœtus and placenta.

About the middle of gestation it is usually from 13 to 21 cm. long, and from 9 to 11 mm. thick. At the time of birth its average length is from 48 to 60 cm., and its thickness 11 to 13 mm.; but it is liable to very great individual variations. It may be as short as 12 cm., or, on the other hand, may attain a length of 167 cm.

The cord is almost invariably twisted spirally on itself, and the cause of this twisting, which commences about the middle of the second month, has been the subject of much discussion. If examined more closely, it is found that all the constituents of the cord are not twisted to the same extent; the spirals described by the umbilical arteries are always far more numerous and closer together than those of the whole cord, or of the veins round which

inferior *vena cava*, which is formed in this way (*cf.* Fig. 34); the umbilical vein, bringing back blood from the chorion, enters the liver of the embryo; as it does so, it is joined by the portal vein, formed by the union of the mesenteric veins from the intestines with the vitelline vein from the yolk-sac. Part of the blood thus brought to the liver passes straight through it by the *ductus venosus*, while part is first taken through the capillaries of the liver and then falls again into the *ductus venosus* close to its exit from the liver; this emerges from the liver as the hepatic vein, which joins a small vein from the posterior extremities to form the inferior *vena cava*.

FIG. 50.



DIAGRAMMATIC FIGURES, SHOWING THE DEVELOPMENT OF THE LARGE ARTERIES FROM THE AORTIC ARCHES OF THE EMBRYO. (From KÖLLIKER, after RATHKE.)

1. Truncus arteriosus, with one pair of aortic arches, and indications of second and third pairs.
2. Truncus arteriosus, with four developed and one rudimentary pair of arches.
3. First and second arches aborted; third, fourth, and fifth pairs present.
4. Arteries of adult, showing their relations to the aortic arches of the embryo; the dotted lines indicate vessels that have become obliterated.

1—5. First to fifth aortic arches. *a*. Aorta. *ad*. Dorsal aorta. *aw'*. Left or persistent root of dorsal aorta. *aw*. Right or obliterated root. *ax*. Axillary artery. *c*. Common carotid artery. *c'*. External carotid. *c''*. Internal carotid. *p*, *p'*. Pulmonary arteries. *s'*, *s''*. Subclavian arteries. *ta* Truncus arteriosus. *v*. Vertebral artery.

By the time the placenta is fairly established, the veins have undergone some further modification. A communicating branch becomes established between the left and right superior *cavæ*, and by means of this branch, which becomes the left innominate vein, the blood of the left superior *cava* is taken to the right auricle through the right *vena cava;* the remaining portion of the left superior *cava* becomes in great part obliterated, a portion of it persisting as the coronary sinus. The cardinal veins have disappeared; while the median vein, formed by the union of the two veins from the legs, which were at first very small, rapidly increases in size and forms the lower part of the *vena cava inferior* of the adult.

The course of the circulation in the fœtus during the later months of pregnancy is shown in the following figure (51). Blood is brought to the right auricle A by two vessels—(*a*) the right superior *vena cava*, Fig. 51, 3 (the left having disappeared), which brings back venous blood from both sides of the head and neck and from the upper extremities by the jugular and subclavian veins of the right and left sides: (*b*) the inferior *vena cava*, 4; this contains venous blood brought from the hinder part of the body, chiefly the posterior extremities and the kidneys, mixed with arterial blood brought back from the placenta by the umbilical vein, 5. A great part of the blood in the umbilical vein passes through the *ductus venosus* and so through the hepatic vein into the *vena cava inferior*, without passing through the liver; while the rest, together with the blood brought from the intestines by the portal vein, 6, only reaches the inferior *cava* after passing through the capillaries of the liver.

The Maternal Membranes.—The earliest stages in the formation of the uterine decidua appear to be, so far as they are known to us, identical with those by which the catamenial decidua is formed. They consist in both cases of increased vascularity of the uterus, accompanied by structural changes in its lining membrane, changes consisting essentially in the formation of a new vascular membrane—the decidua—either by hypertrophy of the previously existing mucous membrane or by a process of new formation, accompanied by enlargement and modification of the uterine glands. Up to a certain point the formation of the catamenial decidua and of the decidua of pregnancy appears thus to be identical, and the sole difference between the two is that in the former the processes having reached a certain point stop, and then become retrogressive, the decidua being broken up and discharged together with a certain amount of blood as the menstrual fluid; while, on the other hand, in the case of the decidua of pregnancy, development after reaching the point mentioned does not stop but continues to be progressive.

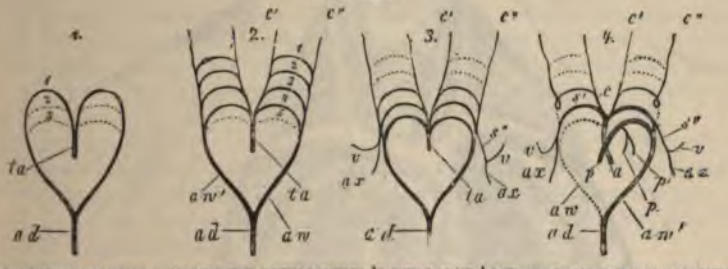
The difference between the two courses appears to depend solely on impregnation having occurred in the latter, but not in the former case, so that the catamenial decidua may be viewed as a preparation on the part of the uterus for an ovum which never reaches it, the decidua after waiting a certain time becoming broken up and discharged. If, however, impregnation is effected and a fertilized ovum reaches the uterus, a new stimulus is set up and the developmental processes instead of stopping go on to further stages, and so give rise to the decidua of pregnancy.

Decidua Vera.—The changes in the mucous membrane of the uterus during pregnancy are of great extent and importance. Before the fertilized ovum reaches the uterus a special vascular membrane has been formed, lining the whole of its cavity. This membrane after reaching a certain stage of development stops, and if no fertilized ovum enters the uterus, after a time breaks up and is discharged with the menstrual flow, and possibly is partly absorbed by the uterine vessels. If, however, a fertilized ovum enters the uterus the membrane continues to undergo progressive development and becomes the *decidua vera* of pregnancy.

The *decidua vera* forms a complete, and at first uniform lining to the uterus; it does not cover the orifices of the Fallopian tubes, which remain open throughout the greater part or whole of pregnancy; neither does it extend into the *cervix uteri*, but stops abruptly at the *os internum*. It attains its greatest development in the early part of the third month, at which time it has a total thickness of from 4 to 7 mm. It consists, according to Köl-liker, of an amorphous ground-substance in which are embedded round and fusiform cells in great numbers. Certain large spherical cells, 0.03 to 0.04 mm. in diameter with sharply defined outlines and conspicuous nuclei and nucleoli, have been named *decidual cells* by Hassall, R. Barnes, and Köl-liker, and appear to be very constant and characteristic elements, though their exact nature is not known. At the free surface of the decidua there is no longer a ciliated epithelium present, and it is, indeed, very doubtful whether any distinct epithelial layer can be described. The whole thickness of the decidua is traversed by very numerous bloodvessels with distinct walls; and is also perforated through and through by a large number of irregularly twisted tubular channels. These channels, which are so numerous as to give the whole decidua a sieve-like appearance, have no distinct walls of their own, and in the great majority of cases not even an epithelial lining, but appear to be merely channels hollowed out in the decidua. They open, as a rule, on the free surface of the decidua into the uterus, while deeper ends are continuous with the mouths of the utricular glands. The musculo-

inferior *vena cava*, which is formed in this way (*cf.* Fig. 34); the umbilical vein, bringing back blood from the chorion, enters the liver of the embryo; as it does so, it is joined by the portal vein, formed by the union of the mesenteric veins from the intestines with the vitelline vein from the yolk-sac. Part of the blood thus brought to the liver passes straight through it by the *ductus venosus*, while part is first taken through the capillaries of the liver and then falls again into the *ductus venosus* close to its exit from the liver; this emerges from the liver as the hepatic vein, which joins a small vein from the posterior extremities to form the inferior *vena cava*.

FIG. 50.



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4. Arteries of adult, showing their relations to the aortic arches of the embryo; the dotted lines indicate vessels that have become obliterated.

1–5. First to fifth aortic arches. *a*. Aorta. *ad*. Dorsal aorta. *aw'*. Left or persistent root of dorsal aorta. *aw*. Right or obliterated root. *ax*. Axillary artery. *c*. Common carotid artery. *c'*. External carotid. *c''*. Internal carotid. *p*, *p'*. Pulmonary arteries. *s'*, *s''*. Subclavian arteries. *ta* Truncus arteriosus. *v*. Vertebral artery.

By the time the placenta is fairly established, the veins have undergone some further modification. A communicating branch becomes established between the left and right superior *cavæ*, and by means of this branch, which becomes the left innominate vein, the blood of the left superior *cava* is taken to the right auricle through the right *vena cava;* the remaining portion of the left superior *cava* becomes in great part obliterated, a portion of it persisting as the coronary sinus. The cardinal veins have disappeared; while the median vein, formed by the union of the two veins from the legs, which were at first very small, rapidly increases in size and forms the lower part of the *vena cava inferior* of the adult.

The course of the circulation in the fœtus during the later months of pregnancy is shown in the following figure (51). Blood is brought to the right auricle A by two vessels—(*a*) the right superior *vena cava*, Fig. 51, 3 (the left having disappeared), which brings back venous blood from both sides of the head and neck and from the upper extremities by the jugular and subclavian veins of the right and left sides: (*b*) the inferior *vena cava*, 4; this contains venous blood brought from the hinder part of the body, chiefly the posterior extremities and the kidneys, mixed with arterial blood brought back from the placenta by the umbilical vein, 5. A great part of the blood in the umbilical vein passes through the *ductus venosus* and so through the hepatic vein into the *vena cava inferior*, without passing through the liver; while the rest, together with the blood brought from the intestines by the portal vein, 6, only reaches the inferior *cava* after passing through the capillaries of the liver.

especially when taken in conjunction with the further fact of the intimate relation between the decidua of pregnancy and the catamenial decidua, those not very uncommon cases in which menstruation occurs at least once after conception has occurred; and also those much rarer cases in which it has been stated to recur regularly throughout the greater part or even the whole of pregnancy.

Decidua Reflexa.—The youngest ovum yet found within the human uterus, that described by Reichert, was already invested by a fully formed *decidua reflexa;* so that concerning the formation of this membrane in the human species we know nothing from direct observation. It was formerly supposed the *reflexa* was formed by the ovum on entering the uterus, pushing before it, and so becoming covered by an "exudation-membrane"—the *decidua vera*—that was already present lining the uterus. We have, however, already seen that this view cannot be correct; for the *decidua* is not an exudation-membrane, neither does it cover the orifices of the Fallopian tubes.

Though the actual formation of the *decidua reflexa* has not been seen, yet it is almost certain that the view advanced by Sharpey is correct—*i. e.*, that after the ovum has attached itself to the *decidua* lining the uterus, the *reflexa* is formed by active growth of the decidua round the ovum so as to encapsule it; the object of its formation being partly to maintain the ovum in contact with the surface of the uterus, and partly, perhaps mainly, to provide an increased extent of vascular surface from which the embryonic villi can draw nutriment.

The structure of the *decidua reflexa* is the same as that of the *decidua vera*. It has the same cribriform character, and is in its early stages exceedingly vascular, the vessels converging from its margin to a small patch of a somewhat cicatricial appearance on its most prominent part, which probably indicates the point of meeting and fusion of the folds by which the *reflexa* is formed.

The *reflexa* at first plays a very important part in the nutrition of the embryo, as the villi of the chorion are inserted into crypt-like depressions in its inner surface, and so obtain nutriment from its vessels (Fig. 46).

After the second month, however, when the placenta is gradually increasing in importance, the villi implanted in the *reflexa* begin to shrink. The vessels of the *reflexa* at the same time diminish in size, and by the fifth or sixth month have completely disappeared.

As the ovum increases in size, the *reflexa* necessarily grows with it: and since this growth is at first more rapid than that of the uterus itself, the *decidua reflexa* will ultimately come in contact with the *decidua vera*, and so completely obliterate the cavity of the uterus (*cf.* Fig. 46). This usually occurs about the sixth month, and the two layers, *vera* and *reflexa*, as a rule not only come in contact but fuse more or less completely together, forming a single membrane of a yellowish-white color, from ½ to 1 mm. in thickness, and usually spongy on its outer side corresponding to the *decidua vera*, and fibrillar on the inner or *reflexa* surface.

Before the *decidua reflexa* meets and coalesces with the *decidua vera*, there is a space between them—the *decidual cavity*. Up to the second, and possibly in some cases the third month, this cavity opens below into the cavity of the cervix, and above into one or both of the Fallopian tubes. This condition is the basis of a theory of superfœtation, since there is thus preserved a free communication between the ovary and the vagina for the concourse of ova and spermatozoa.

Decidua Serotina.—The *decidua serotina* is simply that part of the *decidua* with which the impregnated ovum comes in contact on entering the uterus, and to which it adheres. It is at first, therefore, identical in structure

with the *decidua vera*, of which it is, indeed, part. After the ovum has entered the plexus and fixed itself, thus marking out the site of the future placenta, a distinction is soon established between the *decidua serotina* and the *decidua vera*, owing to the chorionic villi of the ovum being received into depressions in the former; but it is not until near the end of the second

FIG. 46.

PREGNANT UTERUS OF ABOUT THE TWENTY-FIFTH DAY, CUT OPEN LONGITUDINALLY.
(From QUAIN'S *Anatomy*, after COSTE.)

Shows the *decidua vera* (*dv*) lining the uterus, and the *decidua reflexa* (*dr*) forming a capsule round the ovum (*o*); the *decidua reflexa* has been cut open and the flap turned down so as to show the crypt-like depressions of its inner surface, into which the villi of the ovum are received. The figure also shows the ovaries and Fallopian tubes. The right ovary has been cut open to display the *corpus luteum*.

month that any marked difference is established between the *decidua serotina* and the *decidua reflexa*. About this time (*cf.* Fig. 45) the villi opposite the *serotina* become larger and more complicated, and therefore the relations between the fœtal villi and the maternal tissues more intricate, and in this

way the placenta is formed; the *reflexa*, on the other hand, as we have just seen, begins to retrograde, and rapidly becomes of less and less importance.

It appears to be to a great extent a matter of chance with what part of the uterus the ovum will come in contact on entering it, and therefore at what part of the uterus the plâcenta will be formed.[1] In the great majority of cases it is in the neighborhood of the fundus, usually rather to one side of the median line, so as very often to close up the opening of one Fallopian tube, and more frequently on the posterior than the anterior surface. It may, however, be situated in almost any part of the uterus; and its position, as we shall see hereafter, may be a point of much practical importance.

The Placenta.—From what has been said above, it is clear that the placenta consists of two fundamentally distinct elements—*i. e.*, (1) the fœtal portion, formed by the chorionic villi with their contained bloodvessels; and (2) the maternal portion, consisting of the vascular *decidua serotina*. It is of extreme importance to realize fully this double nature of the placenta, and further to remember that each portion, fœtal and maternal, has its own system of bloodvessels; the vessels of the fœtal villi being continuous through the vessels of the umbilical cord with those of the fœtus, and the vessels of the *decidua serotina* being continuous with the general vascular system of the mother. Further, that, however intricately and inseparably connected together the two portions of the placenta may be, yet that the two systems of bloodvessels, fœtal and maternal, always remain perfectly distinct from one another. At no part of the placenta do the fœtal and maternal bloods directly mix.

Up till the middle of the second month the connection between the fœtal and maternal structures is a very loose one indeed, the fœtal villi being merely implanted in crypts in the maternal *decidua*, from which they can without any difficulty be withdrawn. About the end of the second month the fœtal villi begin to enlarge; they give off lateral branches, which again subdivide and so form arborescent tufts, which, owing to their complicated ramifications, can now no longer be pulled away without rupture from the maternal tissue into which they are inserted. At the same time, the capillaries of the maternal tissues—the *decidua serotina*—begin to dilate so as to form large thin-walled loops. The utricular glands persist in a greatly modified form in the deeper musculo-glandular layer of the *serotina;* but the irregular channels by which they discharge on to the surface, and to which the cribriform character of the *vera* and *reflexa* are due, though present in the early stages of the *serotina* soon become inconspicuous.

The above changes go further and further; the fœtal villi with their contained capillary vessels form tufts of increasing complexity; and the maternal capillaries, which have already undergone considerable expansion, now dilate enormously, so as to become converted into large irregular lacunæ or sinuses (the cavernous ektasis of Virchow), the walls of which consist of a single layer of epithelial cells, outside which are the "decidual cells" of the *serotina*.

The villi and lacunæ soon come in contact with one another, and by their further growth the lacunæ completely surround the villi, while the latter, pushing the walls of the lacunæ before them, project into their cavities and so become bathed on all sides by the maternal blood.

The vessels in the fœtal villi, which retain their capillary size, are at first

[1] Ercolani suggests that the ovum on entering the uterus is prevented from at once sinking to the cervix by the fluid secreted by the utricular glands of the uterus, on the surface of which it floats until it comes in contact with and adheres to the wall of the uterus.

separated from the blood in the maternal lacunæ into which they project by (1) the epithelial investment of the villi themselves, which, it will be remembered, is derived from the epiblast of the blastodermic vesicle, and (2) the wall of the lacunæ, which consists of a very thin outer stratum of decidual cells, and an inner layer of epithelium—the original lining of the capillaries from which the lacunæ have been formed by expansion. The epithelial investment of the villi soon atrophies and disappears, so that the fœtal capillaries are separated from the maternal blood merely by the very thin wall of the lacunæ, through which an exchange of gases and nutrient matter can readily be effected.

We shall now be able to understand the structure of the fully formed placenta. The placenta at full time is a discoidal or cake-shaped body[1] of spongy consistency, measuring from 16 to 21 cm. in diameter and 3 to 4 cm. in thickness. The maternal or attached surface is convex, and the free or fœtal surface slightly concave. The blood is brought to the outer or maternal

FIG. 47.

HUMAN PLACENTA; UTERINE SURFACE. (From TARNIER.) × ¼.

surface by a number of arteries which, from their very tortuous course, receive the name of curling arteries: these subdivide and soon lose all their coats except the endothelial lining and an ill-defined outer wall of connective tissue. After a few branchings the arteries open, without forming capillaries, into the enormous sinuses or lacunæ described above. When two of these lacunæ lie close together, side by side, their walls usually fuse to form a membranous septum, and the strongest of these septa form a system of partitions arranged for the most part vertically to the surface of the placenta, and dividing it up into a number of very irregular and unequal cells, which have been compared by Kölliker to a honeycomb. The lacunæ open ultimately into veins which are chiefly placed, like the arteries, on the outer or maternal surface of the placenta; the largest veins run outwards to the edge of the placenta, where they unite to form a marginal anastomotic ring.

Concerning the fœtal portion of the placenta the villi are found as

[1] Whence its name, πλακοῦς, πλακοῦντος.

cotyledons, or tufts of branched finger-like processes, hanging down into the cells of the "honeycomb," and so bathed by the maternal blood: the ends may either hang down freely or else be attached, as the so-called "roots," to the sides or bottoms of the lacunæ. In all cases the villi are not really inside the lacunæ, but simply project into them from the exterior, driving before them the walls of the lacunæ, which form a closely fitting investment to each. Each villus contains a capillary loop in connection, through the vessels of the umbilical cord, with the vascular system of the fœtus.

FIG. 48.

HUMAN PLACENTA; FŒTAL SURFACE. (FROM TARNIER.) ×¼
Amnion dissected off one side to show vessels.

This account is based mainly on the researches of Ercolani and Turner. The description given by Kölliker differs in some important points, which concern, however, not so much the actual anatomical disposition of the parts, as the interpretation to be placed on them. Kölliker regards the epithelial investment of the villi as belonging really to them and not to the lacunæ.[1] He also considers that the lacunæ are not dilated capillaries, but spaces that have primitively no connection with bloodvessels, so that the blood in them must be viewed as extravascular. The difficulties in the way of accepting this view are very great, while the theory supported by Ercolani and Turner has the merit not only of greater simplicity, but also of being far more in accordance with what is known to occur in other mammalia.

In parturition the placenta separates, as a rule, almost immediately after the birth of the child, and is discharged together with the *deciduæ vera* and *reflexa* (usually inseparably fused together) and the amnion. The line of separation of the placenta seems to be the same as that already described in the case of the *decidua vera—i. e.*, the line marking the boundary between the original wall of the uterus and the newly formed decidual tissue. As this line will cut across the outer parts of the lacunæ there will necessarily be considerable hemorrhage accompanying the separation.

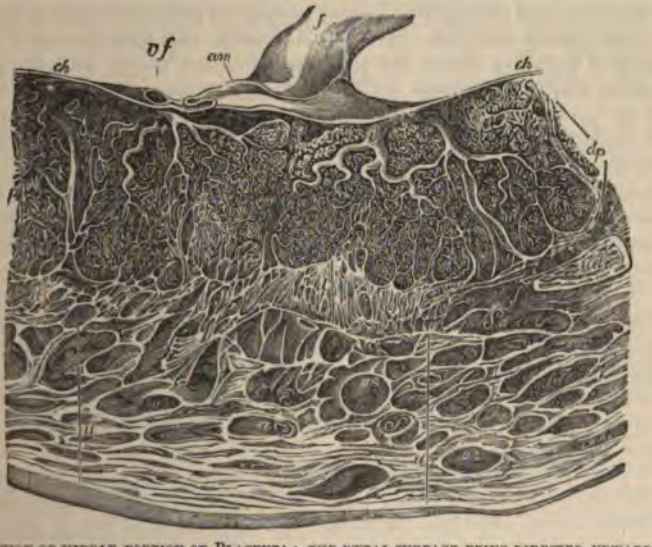
[1] Robert Barnes and Hassall have described and illustrated this view: Barnes, "Memoir on Fatty Degeneration of the Placenta," Med.-Chir. Trans.

Separation of the placenta is effected, as a rule, by the great and rapid contraction of the uterus which follows the birth of the child, and the continuation of this contraction after the placenta is removed is the main agent in checking and restraining the hemorrhage consequent on the removal.

Robert Barnes, after many measurements of placentas, estimates that the average area of the placenta, and consequently of the uterine surface to which it is attached, is from 70 to 80 square inches, whilst the uterine area after the placenta is cast is reduced to 8 or 9 square inches. This enormous contraction explains not only the detachment, but the rupture of the utero-placental vessels and the closure of their mouths.

The umbilical cord is usually inserted near the middle of the placenta; it may, however, be *excentric—i. e.*, some distance from the middle; *marginal*,

FIG. 49.



VERTICAL SECTION OF MIDDLE PORTION OF PLACENTA; THE FŒTAL SURFACE BEING DIRECTED UPWARDS, AND THE UTERINE OR MATERNAL SURFACE DOWNWARDS

am. Amnion. *ch.* Chorion. *f.* Umbilical cord. *us.* Uterine sinuses or lacunæ. *v.* Branches of umbilical artery supplying the fœtal villi.

the "battledore-placenta;" or even beyond the margin of the placenta, into a part of the chorion free from villi. The cord may divide into two parts, inserted separately into the placenta.[1]

The placenta is also liable to modifications other than those of simple position in the uterus. The chief of these, none of which is at all common, are: *Placenta marginata*, in which the *chorion frondosum* only occupies the middle of the placenta and leaves the marginal part bare: *placenta succenturiata*, in which there is a subsidiary placenta more or less completely separated from the main one: *placenta duplex*, in which the placenta is in two

[1] The insertion of the cord is probably governed by some conditions depending upon the seat of attachment of the placenta to the uterus. Thus it has been observed that when the placenta is seated centrally in the fundus, the cord is central; and that in cases of placenta prævia, when the attachment of the placenta spreads into the lower region of the uterus, the cord springs from the margin nearest the os uteri Hence the liability to prolapsus of the cord in these and analogous cases of low placental implantation.—Levret, Robert Barnes.

completely separated halves, and the umbilical cord splits into two parts, one going to each half; this form of placenta is normal among the majority of old-world apes: *placenta tripartita*, a very rare condition, in which the placenta consists of three parts; and *placenta multiloba*, in which it is divided into a great number of completely separate parts, in extreme cases as many as twenty to forty.

(In some rare cases R. Barnes has seen the placenta diffused over the whole area of the uterus, except for a space of four or five square inches.)

The Fœtal Circulation.—The condition of the circulatory organs of the embryo at the end of the fourth week has already been described and figured (*cf.* Fig. 34). At this time the two auricles are only partially separated from one another, and the same is the case with the ventricles. From the ventricular cavity arises the *bulbus arteriosus*, from which are given off the five aortic arches on each side; of these the first and second arches have already in great part disappeared, their persistent portions forming the lingual and external carotid arteries. The third, fourth, and fifth arches of each side are connected together above the pharynx into one trunk, and the trunks of the two sides uniting together form the dorsal aorta. Each third arch also gives off an anterior branch—the internal carotid; from between the fourth and fifth arches arise the subclavian arteries; and from the left fifth arch the pulmonary arteries.

In the course of development the interventricular septum, which appeared first at the lowermost part of the ventricular cavity, the future apex of the heart, gradually extends upward so as to separate the ventricles more and more completely from one another. At the same time a longitudinal septum appears in the *bulbus arteriosus*, commencing between the fourth and fifth arches and gradually growing downwards in a somewhat spiral manner so as to divide the *bulbus* into two tubes placed side by side, whereof one communicates with the fifth pair of aortic arches alone, while the other is in connection with the first four pairs. This septum continues its downward growth until it meets with the upwardly growing interventricular septum, with which it fuses.

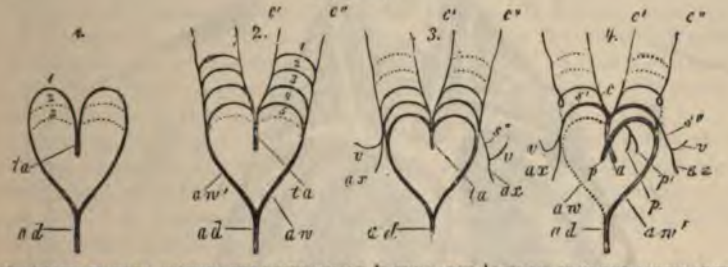
In this way it comes to pass that the two ventricles are completely separated from one another, and that while the left ventricle communicates with the first four arches, the right ventricle can only send its blood into the fifth pair of arches.

At the same time certain changes are being effected in the aortic arches themselves. These consist chiefly in the obliteration of certain portions of the primitive arches, and will be evident from an inspection of Fig. 50. By comparing these figures with one another and with Fig. 34 it will be seen that the chief changes which have occurred are the following: (1) the third arch has, on both sides, lost its connection with the aorta, and now merely forms the internal carotid artery; (2) the fourth right arch has also lost its connection with the dorsal aorta, and now merely forms the right subclavian artery, from which the vertebral artery arises as a branch; (3) the fourth left arch has greatly increased in size and is directly continuous with the dorsal aorta; (4) the fifth right arch has disappeared completely; (5) the fifth left arch gives off both right and left pulmonary arteries, and is still connected by a wide vessel—the *ductus arteriosus* or *ductus Botalli*—with the dorsal aorta.

Concerning the venous system, we have already seen that at the fourth week there are three large veins opening into the right auricle, viz., (1 and 2) the right and left superior *venæ cavæ* or *ductus Cuvieri*, each of which is formed by the junction of a jugular vein from the head with a posterior cardinal vein from the Wolffian bodies and adjacent parts; and (3) the

inferior *vena cava*, which is formed in this way (*cf.* Fig. 34); the umbilical vein, bringing back blood from the chorion, enters the liver of the embryo; as it does so, it is joined by the portal vein, formed by the union of the mesenteric veins from the intestines with the vitelline vein from the yolk-sac. Part of the blood thus brought to the liver passes straight through it by the *ductus venosus*, while part is first taken through the capillaries of the liver and then falls again into the *ductus venosus* close to its exit from the liver; this emerges from the liver as the hepatic vein, which joins a small vein from the posterior extremities to form the inferior *vena cava*.

FIG. 50.



DIAGRAMMATIC FIGURES, SHOWING THE DEVELOPMENT OF THE LARGE ARTERIES FROM THE AORTIC ARCHES OF THE EMBRYO. (From KÖLLIKER, after RATHKE.)

1. Truncus arteriosus, with one pair of aortic arches, and indications of second and third pairs.
2. Truncus arteriosus, with four developed and one rudimentary pair of arches.
3. First and second arches aborted; third, fourth, and fifth pairs present.
4. Arteries of adult, showing their relations to the aortic arches of the embryo; the dotted lines indicate vessels that have become obliterated.

1–5. First to fifth aortic arches. *a*. Aorta. *ad*. Dorsal aorta. *aw'*. Left or persistent root of dorsal aorta. *aw''*. Right or obliterated root. *ax*. Axillary artery. *c*. Common carotid artery. *c'*. External carotid. *c''*. Internal carotid. *p*, *p'*. Pulmonary arteries. *s'*, *s''*. Subclavian arteries. *ta* Truncus arteriosus. *v*. Vertebral artery.

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The course of the circulation in the fœtus during the later months of pregnancy is shown in the following figure (51). Blood is brought to the right auricle A by two vessels—(*a*) the right superior *vena cava*, Fig. 51, 3 (the left having disappeared), which brings back venous blood from both sides of the head and neck and from the upper extremities by the jugular and subclavian veins of the right and left sides: (*b*) the inferior *vena cava*, 4; this contains venous blood brought from the hinder part of the body, chiefly the posterior extremities and the kidneys, mixed with arterial blood brought back from the placenta by the umbilical vein, 5. A great part of the blood in the umbilical vein passes through the *ductus venosus* and so through the hepatic vein into the *vena cava inferior*, without passing through the liver; while the rest, together with the blood brought from the intestines by the portal vein, 6, only reaches the inferior *cava* after passing through the capillaries of the liver.

FIG. 51.

DIAGRAMMATIC FIGURE SHOWING THE CIRCULATORY ORGANS OF THE FŒTUS DURING THE LATER MONTHS OF PREGNANCY. (From QUAIN'S *Anatomy*.)

A. Right auricle. B. Left auricle. C. Right ventricle. D. Left ventricle. *a*. Larynx. *b*. Thymus gland. *c*. Trachea. *d*. Right lung. *e*. Diaphragm. *f*. Liver. *g*, *g'*, *g''*, Intestine. *h*, *h'*. Ureters. *i*. Small intestine. *k*. Bladder. *l*. Urachus. *m*. Rectum. 1, 1', 1''. Arch of aorta and dorsal aorta. 2. Pulmonary artery. 2'. Ductus arteriosus. 3. Superior vena cava. 3', 3''. Junctions of jugular and subclavian veins of right and left sides. 4, 4'. Inferior vena cava. 5, 5x. Umbilical vein. 5'-5''. Ductus venosus. 5''. Hepatic vein. 6, 6''. Portal vein. 7, 7'. Right and left common iliac arteries. 8, 8', 8x. Umbilical or allantoic arteries. 9, 9'. Internal iliac arteries.

Of the two streams of blood thus entering the right auricle, the venous blood from the superior *vena cava* is passed into the right ventricle, while the mixed blood brought by the inferior *vena cava* is directed by the Eustachian valve through the *foramen ovale* (the aperture still persisting in the inter-auricular septum) into the left auricle, from which it passes into the left ventricle.

From the right ventricle (Fig. 51, c) the venous blood is forced by the ventricular systole into the fifth left arch (Figs. 50 and 51) or pulmonary artery; very little of it enters the lungs, which are in an unexpanded condition and therefore offer great resistance to the entrance of blood, so that nearly the whole of it passes through the *ductus arteriosus* into the dorsal aorta (*cf.* Fig. 50), down which it courses to the bifurcation into the two common iliacs, then down these latter, and partly to the lower extremities, but principally along the umbilical arteries, Fig. 51, 8 and 8′, to the placenta, where it gives up certain effete matters and receives nutriment, and whence it returns by the umbilical vein, Fig. 51, *s*.

The blood in the left ventricle, which we have seen is of a mixed character passes along the fourth left or main aortic arch, Fig. 50, and then by the carotid and subclavian arteries to the head and upper extremities; very little, if any of it, passes down the dorsal aorta, which is already filled with the venous blood discharged into it by the right ventricle.

It will be seen that the effect of this arrangement is that the blood returned from the placenta is sent almost entirely to the head and upper limbs of the fœtus, while the lower part of the body only receives blood that has already circulated through the head and upper extremities. The right ventricle, which has to do the greater part of the work of driving the blood to the placenta, has, during fœtal life, walls quite as thick as those of the left.

Changes in Circulation at Birth.—At birth the placental circulation is arrested, and the lungs becoming inflated, the pulmonary circulation is established. In connection with this shifting of the seat of respiration from the placenta to the lungs, certain important changes are effected in the circulation; these are (1) shrinking and obliteration of the *ductus arteriosus* and of the umbilical arteries; (2) obliteration of the *ductus venosus* and of the umbilical vein; (3) closure of the *foramen ovale*.

By these changes it is brought about that the blood in the inferior *vena cava*, as well as that in the superior *vena cava*, passes from the right auricle into the right ventricle. From the right ventricle it is no longer able to pass through the *ductus arteriosus* to the aorta, but can now only pass by the pulmonary arteries to the lungs. From the lungs it is returned by the previously insignificant pulmonary veins to the left auricle, and so to the left ventricle, which drives it not only to the head and upper limbs, but also down the dorsal aorta to the lower part of the body. By the obliteration of the *ductus venosus* all the blood in the portal vein is compelled to pass through the capillaries of the liver in order to reach the inferior *vena cava*. In other words, by these changes—the obliteration of the *ductus arteriosus* and *ductus venosus*, and the closure of the *foramen ovale*—the fœtal circulation has been converted into that of the adult.

The several changes noticed above do not occur immediately on birth, neither are they effected all at the same time. Obliteration of the umbilical arteries occurs first, and is usually complete by the third or fourth day. The umbilical veins and *ductus venosus* remain open rather longer, but are generally obliterated by the sixth or seventh day. The *ductus arteriosus*, according to Allen Thompson, is "rarely found open after the eighth or tenth day, and by three weeks it has, in almost all instances, becor letely

impervious." Finally, complete closure of the *foramen ovale* is the last of all the changes to be effected, and in many cases an oblique valvular aperture, large enough to pass a probe through, persists for the first year of infancy, or may even be permanent throughout life, in which case it is the cause of cyanosis or *Morbus cæruleus*, in which the two bloods, arterial and venous, are mixed.

Physiology of the Fœtus.

Respiration.—The respiration of the fœtus during intrauterine life is effected by means of the placenta, the blood returning from the placenta by the umbilical vein being richer in oxygen, as well as in nutritive matters, and poorer in carbonic acid and excretory products, than that conveyed to the placenta from the fœtus by the umbilical arteries.

The respiratory changes in the fœtus are, however, so slight that there is but very little difference in color between the blood of the umbilical artery and vein. Still, they are by no means unimportant, for it has been shown by Zuntz that if the mother be choked, so that the maternal blood becomes very poor in oxygen, the fœtus is very speedily asphyxiated; and in such a case it appears further that the small amount of oxygen contained in the fœtal blood passes back again through the placenta into the maternal blood, so that death of the fœtus occurs more rapidly than if asphyxia were produced by simple compression of the umbilical cord; for not only is there no further supply of oxygen brought to the fœtus, but what is already present in its blood passes back to the mother.

From this last observation it is almost certain that the process of respiration as effected in the placenta is one simply of diffusion, the blood of the fœtus containing less oxygen than that in the placental sinuses, but having a higher carbonic acid tension, and, therefore, in its passage through the capillaries of the fœtal villi, gaining oxygen and losing carbonic acid.

Up to the time of birth the pulmonary respiratory processes are in complete abeyance; and this has been explained by supposing that the respiratory centre in the medulla receives throughout the whole of intrauterine life blood that is too highly oxygenated to call it into activity; or, to use Dr. Foster's words, "the oxygen supply to the protoplasm of its nerve-cells is never brought so low as to set going the respiratory molecular explosions. As soon, however, as the intercourse between the maternal and umbilical blood is interrupted by separation of the placenta or by ligature of the umbilical cord, or when in any other way blood of sufficiently arterial quality ceases to find its way by the left ventricle to the medulla oblongata, the supply of oxygen in the respiratory centre sinks, and when the fall has reached a certain point an impulse of inspiration is generated, and the fœtus for the first time breathes."[1] The expansion of the thorax thus effected is to a certain extent permanent, and the diminution of the pressure in the pulmonary circulation which it occasions is the main cause determining an increased flow of blood through the pulmonary vessels, and so a decreased flow through the *ductus arteriosus*, which, as we have just seen, rapidly shrinks and becomes obliterated.

Temperature.—In the adult the muscles and the glandular organs are supposed to be the main sources of the heat of the body; in the fœtus, however, these two systems are almost entirely quiescent, and at any rate contribute very little towards maintaining the temperature of the body. It must, however, be borne in mind that, owing to the conditions in which the fœtus is placed, the cooling by radiation or evaporation must be extremely

[1] Foster, Text-book of Physiology, 3d edition, p. 626.

small, so that comparatively very slight metabolic changes suffice to keep the heat of the body at the normal temperature. That an actual production of heat on the part of the fœtus does occur, is evident from the observations of Gusserow, which show that the temperature of the fœtus immediately after birth is constantly from 0.1° to 0.3° C. above that of the uterus and vagina.

NUTRITION.—Concerning the nutrition of the fœtus, Dr. Foster remarks: "If oxygen and carbonic acid thus pass by diffusion to and from the mother and the fœtus, one might fairly expect that diffusible salts, proteids, and carbohydrates would be conveyed to the latter, and diffusible excretions carried away to the former, in the same way; and if fats can pass directly into the portal blood during ordinary digestion, there can be no reason for doubting that this class of food-stuffs also would find its way to the fœtus through the placental structures."[1]

There is indeed no doubt whatever that the materials at the expense of which the fœtus is enabled to increase in size and complexity are derived from the maternal blood in the placenta, although as to the exact form and manner in which this conveyance is effected we have no definite knowledge.

That the character of the maternal blood has a very marked and direct influence on the fœtus, is evident from the occurrence of cases of congenital syphilis transmitted from the mother to her yet unborn offspring; but it would also appear that the nutrition of the fœtus is to a certain extent, and in a peculiar manner, independent of the mother. In evidence of this, Gusserow cites from Fumée[2] the case of a woman who, while suffering from smallpox, bore twins, one of which was born dead with smallpox pustules on the body, while the other was born living and healthy.

Diffusible substances taken by the mother as medicine have been found in the fœtus, proving that such substances can pass directly by the placenta—the only possible route—from mother to fœtus. The best known examples of this are cases of syphilitic women who have taken iodide of potassium during the period of pregnancy, which iodide has afterwards been found in the fœtus. Gusserow,[3] who has investigated a number of these cases very carefully, finds that although iodide of potassium does really pass from mother to fœtus, yet that its passage is exceedingly slow, and that unless administered to the mother for more than fourteen days no traces of it are found in the fœtal urine.

Concerning the nature of the processes by which in the placenta nutrient matter is transferred from the maternal to the fœtal bloodvessels, we know nothing definitely; but it would appear probable that the process is really, at any rate in chief part, simply one of diffusion. Ercolani, relying mainly on the structure of the placenta in lower mammals, maintains that the layer of cells between the maternal and fœtal vessels takes an active share in elaborating the nutrient matter for the fœtus, and speaks of the whole placenta as a "glandular organ" whose main function is this elaboration of food. On the other hand, Dr. Gamgee points out that in cases of extra-uterine fœtation development of the fœtus and placenta proceeds in a normal manner; and yet this layer of special secreting cells (Ercolani) is in these cases represented solely by the ordinary peritoneal epithelium. He also urges that we have in the blood of the mother a supply of diffusible food already elaborated, so that there would appear to be no need or purpose for any special secreting organ.

[1] Foster, Text-book of Physiology, 3d edition, p. 622.
[2] Fumée, Journal de Médecine (1759).
[3] Gusserow. "Zur Lehre vom Stoffwechsel des Fœtus." Archiv f. Gynäkologie. Bd. III. Heft 2.

way the placenta is formed; the *reflexa*, on the other hand, as we have just seen, begins to retrograde, and rapidly becomes of less and less importance.

It appears to be to a great extent a matter of chance with what part of the uterus the ovum will come in contact on entering it, and therefore at what part of the uterus the plăcenta will be formed.[1] In the great majority of cases it is in the neighborhood of the fundus, usually rather to one side of the median line, so as very often to close up the opening of one Fallopian tube, and more frequently on the posterior than the anterior surface. It may, however, be situated in almost any part of the uterus; and its position, as we shall see hereafter, may be a point of much practical importance.

The Placenta.—From what has been said above, it is clear that the placenta consists of two fundamentally distinct elements—*i. e.*, (1) the fœtal portion, formed by the chorionic villi with their contained bloodvessels; and (2) the maternal portion, consisting of the vascular *decidua serotina*. It is of extreme importance to realize fully this double nature of the placenta, and further to remember that each portion, fœtal and maternal, has its own system of bloodvessels; the vessels of the fœtal villi being continuous through the vessels of the umbilical cord with those of the fœtus, and the vessels of the *decidua serotina* being continuous with the general vascular system of the mother. Further, that, however intricately and inseparably connected together the two portions of the placenta may be, yet that the two systems of bloodvessels, fœtal and maternal, always remain perfectly distinct from one another. At no part of the placenta do the fœtal and maternal bloods directly mix.

Up till the middle of the second month the connection between the fœtal and maternal structures is a very loose one indeed, the fœtal villi being merely implanted in crypts in the maternal *decidua*, from which they can without any difficulty be withdrawn. About the end of the second month the fœtal villi begin to enlarge; they give off lateral branches, which again subdivide and so form arborescent tufts, which, owing to their complicated ramifications, can now no longer be pulled away without rupture from the maternal tissue into which they are inserted. At the same time, the capillaries of the maternal tissues—the *decidua serotina*—begin to dilate so as to form large thin-walled loops. The utricular glands persist in a greatly modified form in the deeper musculo-glandular layer of the *serotina;* but the irregular channels by which they discharge on to the surface, and to which the cribriform character of the *vera* and *reflexa* are due, though present in the early stages of the *serotina* soon become inconspicuous.

The above changes go further and further; the fœtal villi with their contained capillary vessels form tufts of increasing complexity; and the maternal capillaries, which have already undergone considerable expansion, now dilate enormously, so as to become converted into large irregular lacunæ or sinuses (the cavernous ektasis of Virchow), the walls of which consist of a single layer of epithelial cells, outside which are the "decidual cells" of the *serotina.*

The villi and lacunæ soon come in contact with one another, and by their further growth the lacunæ completely surround the villi, while the latter, pushing the walls of the lacunæ before them, project into their cavities and so become bathed on all sides by the maternal blood.

The vessels in the fœtal villi, which retain their capillary size, are at first

[1] Ercolani suggests that the ovum on entering the uterus is prevented from at once sinking to the cervix by the fluid secreted by the utricular glands of the uterus, on the surface of which it floats until it comes in contact with and adheres to the wall of the uterus.

CHAPTER VI.

THE PELVIS.

THE main interest which the pelvis presents from the obstetric point of view rests in this structure regarded as a whole. It is when bound together as one compact body that the several component parts acquire obstetric value.

The minute study of the several bones throughout the successive stages of development has, indeed, a high scientific and even applied interest as throwing light upon the origin of the malformations, diseases, and distortions of the pelvis. But this study would exceed the limits necessarily imposed upon this work. We shall, therefore, give but a brief sketch of the component elements of the pelvis, and shall describe more fully the great obstetric structure built up by the consolidation of these elements.

The pelvis is composed of bones and ligaments.

There are four bones: the sacrum, the coccyx, and the two coxal, innominate, or iliac bones.

1. The *sacrum* is a single, symmetrical bone of a quadrangular pyramidal form, wide above, tapering below. It rests between the two ossa innominata, wedged between them. On its posterior surface it presents the crested ridge of the sacral vertebral elements, strongly marked above, less marked below. On either side of this ridge are the posterior sacral foramina. It is convex. The anterior or inner surface is the more important in its obstetric bearings. It is strongly concave, forming the hollow of the sacrum. This is bounded above by the projecting *promontory*, formed partly by the first sacral vertebra, but completed by the last lumbar vertebra, which rests upon the sacrum. The inner surface is smooth, presenting on either side of the median line the openings which give exit to the sacral nerves. At the lower end is the articular surface by which it is united to the coccyx. The sacrum in its origin consists of five vertebræ. These become fused together at the age of eight or ten. It becomes one solid bone at puberty or a little later.

2. The *coccyx* consists of four or five small rudimentary vertebræ. It may be regarded as an appendix to the sacrum. It forms a triangle, the base of which is articulated with the apex of the sacrum. Its anterior surface, concave in continuity with the concavity of the sacrum, is in near relation with the rectum. The posterior surface is rough, convex, and lies almost subjacent to the skin. It can always be felt behind the anus, and thus forms a landmark in examinations. In man the coccyx is rudimentary; in many animals it is developed into the tail.

3. The *os innominatum* or *ilium* or *coxal bone* is one of a pair, articulated behind with the sacrum, and joining its fellow in the median line at the symphysis pubis. It consists of two parts distinct in character: one inferior, flattened from before backwards, nearly vertical; the other, upper, larger, flattened, and projecting from within outwards. These parts uniting form an obtuse angle projecting inwards. The *external* or *femoral aspect* presents about its middle the *cotyloid cavity*. This is hemispherical, smooth, and cartilaginous; it holds the head of the femur; it looks downwards, outwards, and a little forward. A small cavity at its bottom gives attachment to the round ligament which ties the head of the femur to the cavity. The upper part of the external surface is expanded, convex in front, concave behind.

It is traversed by two slightly elevated ridges, the *semicircular lines*, one above, one below. Between the two lines is a broad space, to which is attached the gluteus medius. In front of the inferior line is a still broader space, which receives the insertion of the gluteus minimus. A small space above, marked out by the superior line or curve descending from the edge of the bone a little in front of the posterior superior spine to the greater sciatic notch, at the posterior border of the bone, gives attachment to the gluteus maximus.

The *inferior part of the external surface*—that is, the lower and vertical half of the os coxæ—presents the *obturator foramen*. This hole is bounded above by the *body of the pubes*, directly above it by the *horizontal ramus of the pubes*, outwardly by the *ischium*, a stout column slightly concave in front serving to support the cotyloid cavity, and terminated below by a rounded body, the *sciatic tuberosity*, and inwardly and below by the *ischio-pubic ramus*.

The Internal or Pelvic Aspect.—A projecting line, the *linea innominata* or *iliopectinea*, separates this aspect into two parts. This line has a blunt edge, convex from above downwards, concave from before backwards; it is limited in front by the ilio-pectineal eminence, behind by the sacro-iliac symphysis. This line constitutes a part of the upper strait of the pelvis. The *upper half of the internal surface* looks upwards and inwards; it presents behind a strong tuberosity, the *iliac tuberosity*, convex, very unequal, giving attachment to the ligaments which bind the os innominatum behind to the sacrum; an *articular surface*, called auricular from its shape, corresponding to the sacrum; and more forward is a broad, smooth excavation filled by the iliacus muscle; this is the *internal iliac fossa*.

The *lower half of the internal aspect*, that part below the linea iliopectinea, presents behind a quadrilateral bony surface, smooth, slightly concave, directed obliquely from above downwards, from behind forwards, and from without inwards. This surface constitutes, above, the *floor of the cotyloid cavity*. More in front is the inner surface of the obturator foramen. Above this foramen is the posterior surface of the horizontal branch of the pubes; within and above is the posterior surface of the body of the pubes; within and below is the posterior surface of the ischio-pubic branch; below and behind is the posterior surface of the ischium.

The *circumference* is divided arbitrarily into four borders: 1. *The upper border* or *iliac crest* is marked in front by the *antero-superior iliac spine*, behind by the *postero-superior iliac spine*. It has nearly the form of the letter S. It presents two lips; the external gives attachment to the greater obliquus abdominis muscle, the internal to the transversus muscle, and the line between the lips to the lesser oblique muscle. 2. *The lower border*, the *pubic*, is the shortest. The upper part presents the articular surface which corresponds with its fellow from the opposite side. This surface is an oval facet. The lower part, diverging from its fellow backwards and downwards, is the ischio-pubic branch. 3. The *anterior border*, the *inguinal*, is concave and limited outwardly by the antero-superior iliac spine, inwardly by the angle of the pubes. The posterior part is sinuous; it shows the *antero-superior iliac spine*, which gives insertion to muscles and to the external extremity of the round ligament; below there is a notch; then the *antero-inferior iliac spine*; and lastly, a groove, in which play the united tendons of the psoas and iliac muscles. The anterior portion, horizontal, regular, has a triangular surface, presenting a base, apex, and two sides. The *base* is marked by a rounded eminence, the *iliopectineal eminence;* the *apex* by a sharp prominence, the *spine of the pubes*. This is called the *pectineal ridge* or *crista pubis*. 4. The *lower border* is comprised between the postero-superior iliac spine and the tuber ischii. It is very irregular and presents—*a*, the *posterior and superior*

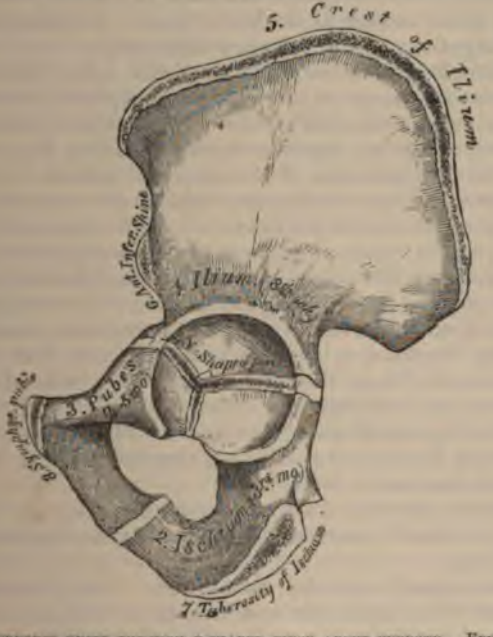
iliac spine; b, a small notch; *c*, the posterior and inferior iliac spine; *d*, a large notch, the *sciatic notch*, destined to form, with the help of the great and small sacro-sciatic ligament, the *greater sciatic foramen*; *e*, a pointed triangular eminence, the *ischiatic spine; f*, a groove serving as a pulley of reflection to the tendon of the obturator internus muscle; *g*, the sciatic tuberosity.

The os innominatum is developed from three primitive points of ossification and eight supplementary points. Of the three primitive points, the first appears in the ilium, from the fiftieth to the sixtieth day of intrauterine life; the second appears in the ischium at the beginning of the fourth month of gestation; the third in the pubic portion at four months and a half. The fusion of the ischio-pubic branch is effected at twelve or fourteen years of age; that of the three primitive points, ilium, ischium, and pubes, meeting in the cotyloid cavity, at fifteen or sixteen.

Of the eight supplementary points, there are three for the cotyloid cavity, one for the anterior and inferior iliac spine, one for the crista ilii and its antero-superior spine, one for the sciatic tuberosity and the ischio-pubic

FIG. 52.

By 8 Centres. { 3 Primary (Ilium, Ischium, and Pubes). 5 Secondary.



THE THREE PRIMARY CENTRES UNITE THROUGH T-SHAPED PIECE ABOUT PUBERTY. EPIPHYSES APPEAR ABOUT PUBERTY, AND UNITE ABOUT 25TH YEAR. (After GRAY.)

branch, two for the spine and angle of the pubes. This survey of the development of the bone is important as throwing light upon the genesis of deformities of the pelvis during childhood. Superincumbent pressure through the sacrum falling upon the cotyloid cavities which hold the heads of the femora tends to concentric collapse if the bones are not well set. Thus the points of chief indentation are those where the several primitive bones, ilium, ischium, and pubes meet. (See Fig. 52.)

These bones may be studied by following the above description, or the more

detailed descriptions of systematic works on anatomy, on the dried separate bones. But the main points may be satisfactorily traced on the consolidated pelvis, which further enables the student to follow the description of the ligaments and other features of the pelvis in its obstetric bearings.

The Pelvis as a Whole.

The component bones are united by joints. 1. The lumbo-pelvic joint, which unites the spinal column to the sacrum. 2. The sacro-coccygeal joint. 3, 4. The sacro-iliac joints uniting each ilium to the sacrum. 5. The symphysis pubis.

The modes of articulation have interesting obstetric bearings.

I. The Lumbo pelvic or Sacro-vertebral Joints.—The sacrum is joined to the fifth lumbar vertebra by three articulations; the middle one is a *symphysis;* the two others, lateral, are *arthroses.*

a. The *sacro-vertebral symphysis* presents two large oval articular surfaces —one on the base of the sacrum, the other on the lower surface of the fifth vertebra. It resembles all the intervertebral disks in having a soft central part and a peripheral fibro-cartilaginous part. It is very obliquely cut, the front part being twice as high as the hinder part. The peripheral ligaments are simply prolongations of the vertebral ligaments.

b. The *sacro-vertebral arthroses;* one on either side. Each presents two articular surfaces, one being on the articular apophysis of the sacrum, the other on the articular apophysis of the fifth lumbar vertebra. They are united by ligaments, one of which is capsular. There is a yellow ligament resembling the yellow ligaments of the vertebral column. The other ligaments bind the sacrum to the bodies and spinous processes of the vertebræ.

II. The Sacro-coccygeal Joint and Intercoccygeal Joints.—The sacro-coccygeal joint is an amphiarthrosis; it is composed of two articular surfaces, an interosseous fibro-cartilage, and four peripheral ligaments. The sacral articular surface is oval, slightly convex; the coccygeal surface is concave to correspond. Cruveilhier says it sometimes possesses a synovial membrane. The interosseous fibro-cartilage is thick, and presents many varieties in the extent of the soft or central portion. Great differences result in the mobility of the articulation. After the age of thirty-five, the fibro-cartilage may undergo ossification, and the mobility is lost. Verneau says it is not rare to find in subjects still young the first piece of the coccyx consolidated with the last sacral vertebra.

III., IV. The Sacro-iliac Joints or Synchondroses.—The bones are held together by powerful interosseous ligaments, the opposing bones being covered by cartilage.

There is also a small synovial membrane. The *ligaments* are of two kinds: four sacro-iliac ligaments and two sacro-sciatic. 1. The *anterior sacro-iliac ligament* is formed by periosteum which passes over the anterior surface of the opposing bones. 2. The *superior sacro-iliac ligament,* analogous to the anterior, but thicker, is formed from the periosteum stretching from the wing of the sacrum to the internal iliac fossa, and passing over the articulation. 3. The *inferior sacro-iliac ligament* rises above from the posterior and upper iliac spine, and is directed downwards to attach itself to the tubercle situated outside the third posterior sacral foramen. Its deepest fibres spring above, from the two posterior iliac spines as well as from the middle notch, and are inserted below over the entire space comprised between the tubercles situated outside of the second and third posterior sacral foramina. 4. The *posterior sacro-sciatic ligament* is the strongest and most

important of all; its deepest fibres are the shortest; it presents two layers; the more superficial, composed of interlacing fasciculi, extends from the posterior part of the iliac crest and the rough surface below it to the tubercles situated outside the first posterior sacral foramina. The deeper layer occupies the large excavation situated directly behind the two articular surfaces, and is attached to the opposing aspect of the bones.

5. The *great sacro-sciatic ligament* is situated on the lateral and posterior part of the pelvis. Its shape is triangular; the base (very wide) is chiefly inserted into the lower portion of the lateral edge of the sacrum and coccyx, and accessorily to the tubercles of the sacrum outside the last three posterior sacral foramina, to the posterior surface of the inferior sacro-iliac ligament and to the postero-inferior iliac spine. The apex is inserted on the external aspect of the sciatic tuberosity. The anterior aspect of the ligament is in relation above with the lesser sacro-sciatic ligament; the posterior surface is covered by the gluteus maximus; the upper border helps in closing the greater sciatic notch, and limits, above, the posterior part of the great sciatic foramen, and, below, the lower part of the small sciatic foramen. The lower edge circumscribes the inferior strait at its lateral and posterior parts.

6. The *lesser sacro-sciatic ligament*, exactly triangular, is situated in front of the greater sacro-sciatic ligament, and is joined with it at its upper part, being separated below by the lesser sciatic foramen. It is attached by its base to the lower part of the border of the sacrum and coccyx, and by its apex to the sciatic spine. The great notch is thus divided into two portions: the first, large and oval, the *great sciatic foramen*, through which pass the pyramidal muscle, the great and small sciatic nerves, gluteal arteries and veins, the sciatic and pudic vessels; the second, triangular, is the *lesser sciatic foramen;* through it pass the tendon of the obturator internus and the internal pudic vessels. These leave the pelvis by the great foramen, turn round the posterior aspect of the lesser ligament, and reënter the pelvic cavity by the lesser foramen.

The two sacro-sciatic ligaments help to consolidate the sacro-iliac articulation. The fœtal head descending into the pelvic cavity pushes back the lower end of the sacrum, transforming this bone into a lever, the action of which tends to dislocate the sacro-iliac joint; but the two sacro-sciatic ligaments oppose this displacement by holding in the lower end of the sacrum, for the more forcible the pressure of the fœtal head, the more strained are the ligaments, and the sacrum, thus pulled in two opposite directions by two equal forces, remains immovable. The sacro-sciatic ligaments moreover serve to complete the walls of the pelvis. Their structure admits of a certain degree of elasticity, and thus diminishes the shock and compression of labor.

V. The Symphysis Pubis, formed by the meeting of the pubic portion of the innominate bones, plays a most important part as a landmark and guide in the mechanism of labor. The opposing bones present a small oval surface covered by a fibro-cartilaginous disk. In females there is a distinct articular surface. Sappey describes it as an amphiarthrosis or symphysis, resembling the articulation of the sacrum with the fifth lumbar vertebra. The interpubic fibro-cartilage is analogous to the intervertebral disks. Behind, this fibro-cartilage is thicker than in front, and projects beyond the bones, forming a ridge or knob, felt on making a digital examination. The centre of this fibro-cartilage is softer, simulating a synovial surface. In pregnancy, this soft portion is enlarged, and gives a slight degree of mobility to the symphysis.

The joint is further secured by *ligaments*. *Peripheral ligaments*. 1. The *anterior* is composed of periosteum; it is strengthened by tendinous fibres of the muscles inserted upon the body of the pubes. This ligament is thick

and strong. 2. The *posterior* is thicker still, and resembles it in origin and disposition. 3. The *inferior subpubic* or *triangular ligament* is much thicker. Its upper border adheres in the centre to the interosseous fibro-cartilage; its ends are attached to the descending rami of the pubes; its concavity forms the roof of an arch, the *pubic arch*, under which the child's head revolves as it passes the vulva.[1]

The mobility of the pelvic joints is a question of great practical interest. As a general fact, it may be stated that the degree of mobility is commonly very slight; nor can it be said that the pelvis forms a rigid case. The several joints strengthen each other. It must be clear that no one joint, excepting the sacro-coccygeal, moves much if the rest are fixed. Thus, under ordinary circumstances, *the movement of the pubic symphysis* is very slight; but if the pubic symphysis be separated from the iliac bones by sawing through the pubic rami, it will be found that the two portions remaining can be moved freely. Hence, in discussing the operation of *symphysiotomy*, or division of the symphysis pubis, in order to enlarge the circumference of the pelvic brim, we have to postulate a yielding of the sacro-iliac joints.

What, then, are the movements of the sacro iliac joints? These joints are hardly susceptible of movement if the pelvis is intact; but if the pubic symphysis be sawn away and the sacrum be held fixed, the os innominatum may be made to execute a movement of opening and shutting upon the sacrum.

The *sacro-coccygeal movements* are extensive and important. Under labor, the fœtal head at the outlet forces the coccyx back to the extent of an inch, expanding the outlet of the pelvis to that extent in the conjugate diameter—*retropulsion*. Lenoir (1865) maintains that part of this retropulsive movement is due to the yielding of the first two coccygeal joints, so that the coccygeal curve is straightened. This intercoccygeal movement is sometimes preserved even when the sacro-coccygeal joint is anchylosed and fixed. The *sacro-vertebral joints* permit of slight movements. They share in the general movements of the pelvis on the vertebral column. These are movements of flexion and extension, of lateral inclination and even of circumduction. The movements of flexion and extension alone have an obstetric interest. The vertebral column can bend itself upon the pelvis, and the pelvis may bend itself upon the vertebral column. By these movements the relation of the planes and axes of the pelvis to the horizon or to the vertebral column are considerably modified. Thus, when the woman lies with her knees drawn up and the body curved forward, the axis of the pelvic inlet is made to approach parallelism with the spinal column. This attitude is instinctively taken by women when labor-pains come on. In the upright attitude, the convexity of the lumbo-dorsal spine is increased, the sacro-vertebral prominence especially is increased, the lower part of the sacrum is tilted up, the pubic symphysis is lowered; the axis of the brim approaches more to the horizon. Zaglas and Duncan contend that the sacrum may execute a movement of oscillation under the vertebral column—that is, that the base of the sacrum may move backwards and forwards, the promontory advancing and retreating so as to lessen or increase the conjugate diameter of the pelvis; and Duncan explains very plausibly the different positions taken by women in labor according to the stage of advance of the head. Tarnier and other authorities do not accept this view; and it appears to us, as the result of some study, that the assumed advance and retreat of the promontory is more apparent than real. The amount of movement permitted between the fifth lumbar vertebra and the base of the sacrum must be extremely limited. A careful observation of the form of the joints, the rela-

[1] Those who would pursue the study of the pelvis minutely should refer to Wood's article, "Pelvis," in Todd's Cyclopædia.

tions of the bones, and the strength and bearings of the ligaments, is sufficient to prove this. The degree of backward and forward movement between any two of the lumbar vertebræ themselves is very small. The aggregate arching and straightening movements of the lumbar vertebræ combined with that of the sacrum are very appreciable. In this way the forward arching of the lower lumbar vertebra and sacrum together constitutes a virtual promontory. But the *true sacral promontory* is nearly fixed. The degree to which a *false promontory* may attain is well illustrated in cases of scoliosis.

A closely correlated point is the question, *What increase of space is to be obtained from the yielding of the ligaments which contribute to make up the framework of the pelvis?* There can be little doubt that the sacro-sciatic ligaments retreat to a small extent before the pressure of the child's head. As these ligaments are elastic they quickly recover their former state, so that it is difficult to estimate the extent of their yielding capacity. In the dried pelvis all is rigid, and experiments to illustrate the mechanism of labor made with a dead child on such a pelvis are not altogether trustworthy exponents of what takes place in the living subject.

The Softening of the Pelvic Joints in Pregnancy and Labor.—The question must be examined from two points of view: first, during gestation; secondly, during labor and puerpery.

1. Softening of the Pelvic Joints During Gestation.—Softening has been observed in pregnant women and in subjects dying after abortion, so that the process cannot be due to the pressure encountered in labor. Hodge saw a marked case at the fifth month. Blundell relates four cases. Other cases have been observed. The analogical argument from animals is strong. In some mammalia the bones become so loose during gestation that they are almost lost in the midst of the soft parts. Robertson says: "In certain animals the cartilaginous union of the ossa innominata at the pubes becomes ossified. This is hardly ever the case in woman. In her, the pubic and sarco-iliac symphyses admit of slight relaxation and motion. By far the most remarkable example of it is in the guinea-pig. A pregnant one, expected to farrow the following night, was laid on her back; the *hinder extremities fell apart* and lay flat on the table, indicating that there was no firm union at the pubes. Applying the finger externally showed there was an open space of at least an inch. It was then killed. In the uterus were three apparently full-grown fœtuses, so disproportionably large in reference to the size of the mother, that they could not escape through the pelvis of so small an animal unless this were facilitated by some special provision." The skull was insusceptible of moulding. Chailly asserted that softening of the ligaments was a constant phenomenon in gestation. Jacquemin thinks the ligamentous union of the pelvic bones is always swollen to a third or even greater volume. Velpeau endorses the views of Chailly. Lenoir affirms that there is a decided widening of the pelvic diameters during pregnancy. Dubois recognized the mobility. Fordyce Barker relates some striking instances.

2. Softening of the Pelvic Joints during Labor and Puerpery.—Observations showing relaxation of the joints after labor are numerous and conclusive. Bertin and Bouvard in a celebrated thesis demonstrated the relaxation of the joints on a specimen. Dusch, van Swieten, Smellie, Levret, Desault, Boyer, and others relate cases actually observed. Laborie, in an instructive memoir,[1] contends for the affirmative. D'Outrepont says that in all dissections of puerperal women he recognized a considerable

[1] Gazette de Paris, 1862.

widening of the three pelvic symphyses. This he never failed to find in all the bodies of women dying during pregnancy or labor. He refers to Meckel as confirming this fact. Denman recognized the mobility, and gives a good description of the affection. Knox and Rokitansky confirm these observations. We ourselves have seen instances which leave no doubt in our minds. Dr. Snelling[1] collects many of the recorded facts.

3. A third question arises: Is THE SOFTENING CONSTANT IN GESTATION AND IN LABOR? or, in other words, Is IT OF PATHOLOGICAL IMPORT?

The evidence is sufficient to prove that in gestation the interosseous tissues and the ligaments swell in common with all the pelvic structures; and the frequency with which mobility has been observed, without being followed by any disease or impairment of the joints, is sufficient to prove that the phenomenon is physiological. The relaxation is not produced during labor; it is consecutive upon the relaxation of gestation.

In labor many women complain of a feeling of strain upon the pelvis, as if they were splitting open at the joints. Much reliance cannot be placed upon this subjective sensation. But in a certain proportion of cases a real looseness of the joints after labor is not only obvious to the subject, but also to the physician. Most get well without exhibiting any sign of arthritis or other mischief. Such cases, then, may be regarded as slight excesses of the physiological process. In some cases evidences of arthritis have appeared. But these probably began physiologically, the morbid process being the product of some local or constitutional accident. Stoltz, however, insisted that the relaxation is almost always of a pathological origin. But it is certain that in a large proportion of cases the subjects were healthy. In cases related by Trousseau, Hayn, and others, the subjects being tuberculous, inflammation and suppuration were found in the joints. We must not forget that distant joints—the knee, elbow, shoulder, hip—are subject to suppurative inflammation under certain puerperal complications.

DIAGNOSIS.—The chief point to which attention is drawn is impairment of the power of standing or walking. In one case, observed after labor, Fordyce Barker was struck with the circumstance that the patient could stand with comparative ease resting upon either leg, but that she could not balance herself upon both legs at once.

DURATION AND TREATMENT OF THE SEVERE CASES.—The patients get relief by adapting a firm girdle round the pelvis, so as to compress the joints. Under the use of this contrivance and rest, some cases recover in a few months, but some remain crippled for years. It does not appear possible to restore to joints which have been widely separated, and whose ligaments have been overstretched, their normal compactness.

These propositions may be stated:

1. There is mutual adaptation in labor between the child's head, and the canal through which it has to pass.

2. The head yields most in this adaptation.

3. The bony pelvis is not absolutely rigid; it yields a little at the joints, and the complementary ligaments also yield a little.

4. Under this combined yielding of all the factors much violence is avoided to mother and child. Probably the intrapelvic muscle and fascie would be more frequently torn if the bones and ligaments were absolutely fixed.

[1] American Journ. of Obstetrics, 1870.

The Soft Parts of the Pelvis.

We have now to consider the pelvic skeleton with its ligaments, as it is when clothed with muscles and other soft structures. These soft parts, especially the muscles—leaving aside for the present the uterus and vagina—are material factors in the mechanical problem of labor. Other soft parts, as the vessels and nerves, are concerned in various phenomena arising in connection with labor.

The *external surface* may be very briefly described. The sacro-coccygeal region is covered by skin and the insertions of the sacro-lumbar muscles, which fill the channels on either side of the spinous processes; a strong aponeurosis covers them in. The coccyx is covered by them and a little connective tissue. The spines of the sacrum can be traced along by the finger continuously with the spines of the lumbar and dorsal vertebræ. These spines serve as landmarks in exploration. The depression between the base of the sacrum and the fifth and fourth lumbar vertebræ is especially important as indicating the position of the sacral promontory internally. It is one point used in measuring the outside antero-posterior or conjugate diameter of the pelvis; the other point being the outer surface of the symphysis pubis, also easily felt.

Between the vulvar and sacro-coccygeal regions very thick fleshy parts are found which make up the root of the thigh and the gluteal region. The rectus internus, the adductors, the external obturator, and gluteus maximus muscles present the chief interest. The adductors, very powerful muscles attached to the outer surface of the pelvis and to the femur, bring the thighs together, opposing sexual intercourse (hence styled *custodes virginitatis*), and opposing the passage of the head in labor and obstetric operations.

The Soft Parts which Line the Interior of the Greater Pelvis.—The internal iliac fossa is covered by the iliac muscle, a broad, radiated, triangular fleshy mass. Its fibres spring from the entire surface of the fossa, and, gathering together, pass under Poupart's ligament, uniting with the tendon of the psoas, to be inserted on the lesser trochanter. It serves as a cushion to the gravid uterus. When it contracts it flexes and abducts the thigh. The channels on either side of the sacral promontory are partly filled by the *psoas magnus*. This muscle is fusiform. Springing from the sides of the lumbar vertebræ, it traverses the pelvis along the border of the brim, overlapping it a little. It passes under the femoral arch; its tendon, to which the iliacus becomes attached, is inserted in the lesser trochanter. It flexes the thigh and pelvis upon the vertebral column. The muscles are covered in by an aponeurosis—the *fascia iliaca*. This fascia supplies a sheath for the external iliac vessels.

The *aorta* divides at the level of the lower part of the fourth lumbar vertebra, forming the *two common iliacs*. These run downwards and outwards, crossing obliquely the side of the body of the fifth lumbar vertebra, thence along the inner edge of the psoas muscle, and reaching the level of the sacro-iliac articulation, bifurcate to form the external and internal iliac arteries. The ureters and ovarian vessels pass in front of them.

The *internal iliac artery* plunges into the true pelvis, whilst the *external iliac artery* keeps the course of the common iliac, adhering to the inner border of the psoas, thus reaching the crural arch, under which it runs and becomes the *femoral artery*. It throws off the *epigastric* and *iliac circumflex arteries*.

The Veins.—The *external iliac vein* is the continuation of the femoral. It runs from the crural arch to the sacro-iliac symphysis, where it joins the

hypogastric vein, to form the common iliac vein. In the greater part of its course the external iliac vein is placed inside the artery and attached to it; near the sacro-iliac joint it gets behind the artery. The compression of this vein by the gravid uterus is said (Tarnier) to explain the frequency of varices in the legs. But this factor, not to be disregarded, is, we believe, less operative than is the general vascular tension and turgescence of gestation.

The *common iliac vein* springs from the union of the external and internal iliac veins. Running upwards and inwards to the level of the joint of the fourth and fifth lumbar vertebræ, it joins the vein from the opposite side to form the *vena cava inferior*. This trunk is situated to the right of the aorta.

The *nerves* which traverse this region are *two:* the crural nerve and the genito-crural. The *crural nerve* rises from the lumbar plexus, is directed downwards, and traverses the iliac fossa, where it is placed between the iliac fascia and the psoas-iliacus, to which it furnishes twigs. Lower down, it gets under the crural arch, and gives branches to the muscles of the thigh; other branches supply the skin. The genito-crural nerve also rises from the lumbar plexus, runs downwards, and gets behind the iliac fascia, descending to the femoral arch. There it bifurcates; the internal branch runs through the inguinal canal and distributes itself in the labium majus. The external branch continues its course to the skin of the thigh.

Modifications of the Upper Pelvis by the Soft Parts.—The iliac muscle lessens the depth of the iliac fossa. The psoas muscles and the vessels attached to their inner border cover at the side the entrance of the pelvic brim from the sacro-iliac symphysis to the iliopectineal eminences, so that this strait is transformed into a curvilinear triangle. These muscles and vessels therefore conceal a part of the upper strait, and considerably alter its width. The transverse diameter is thus shortened more than half an inch, or 1.5 cm. The oblique diameters are scarcely affected. Thus the transverse and oblique diameters are nearly equalized. How, then, do we explain the fact that the fœtal head almost always enters in the oblique diameter? Tarnier suggests as the most plausible theory that the transverse diameter is too near the sacro-vertebral angle, and that the biparietal diameter of the fœtal head is too long to permit it to engage in the brim at this level and in this direction, for one of the parietal protuberances would be arrested by the promontory. We have been accustomed to explain the oblique presentations in the following manner: In the first place a certain proportion of entrances at the brim are really transverse; secondly, the lower segment of the uterus containing the fœtal head is seized between the bellies of the opposing psoas muscles. If the slightest obliquity of the head exist, or if, as almost always is the case, one end of the lever formed by the fœtal head offer more surface for the psoas to act upon than the other end, it is necessarily driven forwards in advance of the transverse diameter of the brim—that is, the head assumes the oblique position. The occipital dip also disposes to screw-rotation.

The psoas-iliacal muscles, by their thickness, increase the depth of the pelvic cavity at the posterior part. The psoas muscles, when in tension, impede the entrance of the fœtal part. It thus becomes useful to relax them by flexing the limbs. The part of the upper strait comprised between the middle of the promontory and the sacro-iliac symphysis is covered by the fifth branch of the lumbar nerves, by the common iliac artery and vein, by the origin of the internal iliac artery and vein. At the left also we find the commencement of the rectum.

The Soft Parts which Line the Cavity of the True Pelvis.—To the right and left are the pyramidal muscle and the internal obturator muscle.

front are the bladder and urethra; behind, the rectum. Vessels and nerves also are found.

1. The *pyramidal muscle* is inserted by several digitations to the anterior face of the side of the sacrum, outside the last four sacral foramina, and to the highest part of the great sacro-sciatic ligament. The muscle then passes across the great sciatic notch, which it partly fills, accompanied by the sacral plexus and the sciatic and gluteal vessels. Thence the fleshy fibres run to a tendon, which is inserted in the great trochanter. At the level of the great sciatic notch the muscle is covered by the gluteus maximus. An *investing aponeurosis* covers the pyramidal muscle throughout its whole intrapelvic course. It closes the great sciatic foramen, and is inserted into the border of the sciatic notch to the sciatic spine at the side of the sacrum. In front it is continuous with the *pelvic aponeurosis.*

2. The *obturator internus muscle* is inserted over the surface which corresponds to the cotyloid cavity, over the circuit of the obturator foramen, on the obturator membrane; its fibres unite to a tendon which passes through the small sciatic foramen, and is inserted into the great trochanter. It is covered by an aponeurosis, which is divided into two layers by a fibrous arch—the pubio-sciatic—which, adhering to the aponeurosis of the muscle, runs as a cord from the pubes to the ischiatic spine, and gives attachment to the levator ani. The part of the aponeurosis above the pubio-sciatic arch is continuous with the pelvic fascia; the part below this arch forms, by its posterior surface, the external ischio-rectal hollow.

The *bladder* is situated behind the pubes. It varies greatly in size according to its contents. The relations of the bladder and other pelvic organs will be described when tracing the peritoneum.

The *rectum* begins at the level of the left sacro-iliac symphysis, reaches the median line near the third sacral vertebra, then follows the anterior surface of the sacrum and coccyx, and terminates a little in front of the coccyx by traversing the perineal floor. From an obstetrical point of view, the rectum may be divided into two parts: the upper, applied to the sacral hollow, may be compressed by the fœtal head in its descent; the lower part enters into the perineal floor, and may participate in its distention. This is so marked that in some cases the lower inch or more of the rectum may be everted, and fissured. The *arteries* of the rectum are the *superior hemorrhoidal,* which come from the inferior mesenteric; the *middle hemorrhoidal,* which come direct from the hypogastric; and the *inferior hemorrhoidal,* coming from the internal pudic. The *veins of the rectum* all empty themselves into the inferior mesenteric. Those which come from the mucous membrane form *a remarkable network* in the submucous connective tissue, greatly developed at the level of the semilunar folds. This dilatation, especially marked during gestation and labor, gives rise to *hemorrhoids,* or *piles.* The *lymphatic* vessels of the rectum are numerous. They come from the mucous membrane, and run into a series of ganglia situated along the posterior aspect of the rectum. This abundance of lymphatics accounts for the faculty of absorbing nutritious and medicinal agents which is sometimes so usefully appealed to.

The *nerves* come mostly from the great sympathetic, some from the cerebro-spinal system.

Vessels and Nerves of the Walls of the Pelvis.—We have seen that the internal iliac or hypogastric artery branches off from the common iliac; it descends in front of the sacro-iliac synchondrosis, the pyramidal muscle, and the sacral plexus. It divides into a number of branches—umbilical, vesical, middle hemorrhoidal, uterine, vaginal, gluteal, obturator, ilio-lumbar, lateral sacral, ischiatic, and internal pudic. The *middle sacral*

artery springs direct from the aorta. It descends vertically, and is very small. *Veins* corresponding in name with the arteries accompany them.

The *nerves* mostly come from the sacral plexus. This plexus is formed by the union of the anterior sacral nerves and the lumbo-sacral branch. It has the form of a triangle, whose basis occupies the entire length of the sacrum, and whose apex, directed outwards, answers to the great sciatic notch above the spine of this name. There the branches of the sacral plexus unite to form a large trunk—the *sciatic nerve*—which supplies the lower extremity. The cramps so often complained of during labor are partly due to the pressure of the fœtal head upon the sacral plexus. The *internal pudic nerve* detaches itself from the plexus, accompanies the pudic artery, and is distributed to the muscles of the vagina and perineum, to the vulvar region. The *obturator nerve* comes from the lumbar plexus, traverses the psoas, passes the angle of bifurcation of the common iliac vessels, and, leaving the pelvis

FIG. 53.

(After SAVAGE.)

a. Psoas muscle. *b*. Common iliac artery and vein. *c*. Internal iliac artery and vein. *d*. Saphena vein and rectum. 1. Superficial lymphatics of the groin. 2. Saphena lymphatic glands. 3. Superficial inguinal glands. 4. Deep inguinal glands. 5. External iliac lymphatics.

by the obturator foramen, gives branches to the adductor muscles. This nerve is liable to pressure from the fœtal occiput in occipito-anterior positions; and R. Barnes has frequently diagnosed the position of the head at the end of gestation and in labor by the pain referred to the distribution of this nerve.

MODIFICATIONS OF THE PELVIC CAVITY BY THE SOFT PARTS. — The obturator and pyramidal muscles are thin, and cannot much alter the dimensions of the pelvic diameters.

The *lymphatics* play such an important part in the physiology and pathology of gestation and puerpery that they call for particular attention. These eminently absorbing vessels begin at the periphery.

First, we notice the *superficial or subcutaneous lymphatics*, which come from the thigh, and unite with superficial vessels and glands; secondly, deep lymphatic glands, which receive the deep lymphatic vessels which accompany the femoral artery and vein. The superficial and deep glands communicate. Thirdly, we may trace in Fig. 54 (1, 2), superior lumbar glands, receiving the upper or spermatic set of lymphatics from the uterus and appendages, some of the renal lymphatics, some of the lacteals, and the efferent communicants from the (3) inferior lumbar glands, which receive the efferent lymphatics from the sacral and iliac glands; (4) the sacral lymphatic glands, receiving lymphatics from the iliac glands and the lymphatic communicants from the very abundant lymphatics of the rectum; (5) external and internal iliac glands; (6) common iliac glands, receiving inferior uterine

lymphatics from (5, 7) spermatic lymphatic plexus, the uterine portion of which generally appears as a large separate lymphatic trunk.

In the same figure may be traced: *a*, left renal vessels covered by some ascending lymphatic efferents, which join the common duct higher up; *b*, the left renal vein, resting on the termination of the lumbar efferents with the *receptaculum Chyli*; *c*, left spermatic vein; *d*, left spermatic vessels covered by their lymphatic plexus; *e*, aorta, having the roots of the receptaculum

FIG. 54.

(After SAVAGE.)

1, 2. Superior lumbar glands. 3. Inferior lumbar glands. 4. Sacral lymphatic glands. 5. External and internal iliac glands. 6. Common iliac glands. *a*. Left renal vessels. *b*. Left renal vein. *c*. Left spermatic vein. *d*. Left spermatic vessels covered by their lymphatic plexus. *e*. Aorta. *f*. Common iliac trunks. *g*. Ascending cava. *h*. External iliac artery and vein. *m*, *n*. Ureters. *o*. Right common iliac vein. *p*. Iliacus muscle. *s*. Psoas muscle. o. Ovary reversed to show lymphatics between it and its bulb. K. Kidney. T. Fallopian tube.

on the right (generally on the left) and beneath the aorta; *f*, common iliac trunks; *g*, ascending cava; *h*, external iliac artery and vein; *m*, *n*, ureters; o, right common iliac vein; *p*, iliacus muscle; *s*, psoas muscle; o, ovary turned down in order to show lymphatics between it and its bulb.

The Abdominal Walls.—The upper border of the pelvis gives attachment to the flattened out soft structures which make the abdominal cavity. The abdomen is divided into nine secondary regions by four fictitious lines; two vertical, rising from the middle of the horizontal branches of the pubes to the lower border of the ribs; the others horizontal, cutting the verticals at right angles, the upper one below the false ribs, the lower one at the level of the two antero-superior iliac spines. Thus are obtained the nine regions: in the upper zone are, in the middle, the *epigastrium*, on either side, the *hypochondria*; in the middle zone are the *umbilical region* and *the flanks*; in the lower zone are the *hypogastrium and the iliac fossæ*.

The *posterior wall of the abdomen* is narrow and forms the skeleton of the abdomen. It is formed by the lumbar vertebræ. Behind the bodies of the vertebræ are found on either side, the sacro-lumbar, the dorsal, and the transversalis muscles, and their investing aponeurosis; more superficially

are the subcutaneous cellular tissue and the skin. In front of the bodies of the lumbar vertebræ are the insertions of the diaphragm, the two psoas muscles, the abdominal aorta, accompanied on its right side by the ascending vena cava, the thoracic duct, and a series of lymphatic glands. The relations of the aorta to the vertebral column explain how it is that this vessel can be compressed after labor.

The *antero-lateral walls* stretch from the lower part of the chest to the upper border of the pelvis. They consist of six layers—namely, skin, subcutaneous cellular tissue, the investing aponeurosis (Richet), the muscular coat, the subperitoneal fascia, and the peritoneum.

FIG. 55.

DIAGRAMMATIC SCHEME OF REGIONS OF ABDOMEN.

The recti muscles, broad and flat, run from the superior border of the pubes to the cartilages of the fifth, sixth, and seventh ribs. They touch each other at their internal edge, near their inferior attachment, and separate a little as they approach their upper attachments.

The strength of the abdominal walls is greatly due to the muscles and aponeuroses. These two elements are intimately united. The weakest part, or at least that which most frequently gives way, is the median line where the recti meet. This not infrequently opens out under the violence of labor so as to leave little more than peritoneum, cellulo-adipose tissue, some aponeurotic fibre and skin to form the wall. Intestines may then push out this imperfect wall and form a *ventral or umbilical hernia*. The practical lesson from this is to support the abdominal wall during labor, and to keep the parts well supported afterwards with a binder, so as to help them to recover their normal condition.

Quite below, inside the spine of the pubes, between this spine and the symphysis, the aponeurosis of the internal oblique divides into two divergent bands, leaving an oval opening just admitting the tip of the finger. This is the *inguinal ring*, the external end of the *inguinal canal*, obliquely running in the thickness of the musculo-aponeurotic layer of the abdomen. Through this ring passes the round ligament. In the fœtus this round ligament is accompanied in part of its course by the peritoneum, forming a cul-de-sac,

the *canal of Nuck*. It is along this canal that the small intestine or the ovary passes in inguinal hernia.

The muscles and aponeuroses of the abdomen form an elastic belt surrounding this cavity. They are inserted behind on the vertebral column, above to the base of the thorax, below to the upper border of the pelvis. Usually this belt supports the viscera; it may yield by its elasticity under pressure from within, or contracting promptly it compresses the viscera, and may cause those which communicate with the external surface to void their contents. If the pelvis is first fixed, the abdominal muscles contracting pull down the thorax and flex the spinal column. If the chest be fixed, the muscles contracting may pull up the anterior wall of the pelvis, and also flex the vertebral column.

The abdominal walls are liable to great distention. They enjoy a certain degree of resiliency; but the recovery of their ordinary degree of flatness is mainly due to the active and tonic contraction of the muscles. The skin stretches to almost any extent. But part of the enlargement of the superficies of the skin is probably due to *growth*, keeping pace with the growth of the gravid uterus; part, however, is well known to be due to stretching, a process which, exceeding the rate of growth, involves cracking of the dermis. Hence the *lineæ albicantes* seen on the abdomen of women who have borne children. The peritoneum, to keep pace with the distention of the abdominal wall, also grows. It has not, we think, been observed that this membrane cracks like the skin at this part. But on the surface of the uterus, under conditions that will be described under "Rupture," cracks may be produced.

The Pelvic Floor.—The outlet of the bony pelvis is completed and guarded by a combination of tissues—peritoneum, mucous membrane, connective tissue, muscles, vessels, glands, and skin—which constitute the pelvic floor. This compound structure, viewed as a whole, plays a very important part in the physiology and pathology of generation. The pelvic floor forms a thick fleshy elastic layer, dovetailed in all round to the bony pelvic outlet. It may be considered as an irregularly edged segment of a hollow sphere, with an outer *skin* aspect, and an inner *peritoneal* one. The external genitals have been described. On the inner peritoneal surface lie the uterus, tubes, and ovaries. The vagina runs at an angle of 60° to the horizon from the vaginal orifice upwards to the mouth of the womb as a transverse slit in the pelvic diaphragm. In front of the vagina lies the bladder, behind it the rectum.[1]

The pelvic floor is made up of two segments, the *pubic* and the *sacral*.

1. The *pubic segment* is made up of loose tissue, bladder, urethra, anterior vaginal wall, and bladder-peritoneum. It is loosely attached in front to the symphysis pubis. The bladder and urethra, meeting at right angles, are separated from the pubes by the pyramidal deposit of loose fat.

2. The *sacral segment* is attached to the coccyx and sacrum; it consists of strong tendinous and muscular tissue. The inferior portion of this segment, the perineum, lies about an inch and a half from the symphysis.

The pubic segment is also attached on each side to the anterior bony pelvic wall, while the sacral segment is attached in a like manner to the posterior bony pelvic wall. Finally, the two segments blend with one another on the right and left sides of the vagina.

The two segments are thus *anatomically* contrasted:

The pubic segment is made up of loose tissue, and is loosely attached to the symphysis pubis; the sacral segment is made up of strong tissue, and is firmly dovetailed into the sacrum and coccyx.

[1] Our description is chiefly borrowed from Hart and Barbour's Manual of Gynæcology, 1882.

They are further contrasted *functionally*. In labor the pubic segment, at first driven down, is then drawn up, forming, with the anterior lip of the cervix uteri, R. Barnes's *first valve* (see "Mechanism of Labor"); the sacral segment, R. Barnes's *second or perineal valve*, is driven down. Hart likens this, not inaptly, to the action of two folding doors. Uterine action pulls up the pubic segment, and drives the child down against the sacral segment. This is analogous to the way one passes out through two folding doors, where one pulls one door towards him and pushes the other from him. A more exact comparison would be with two doors close together, one in front of the other, hinged one to the right the other to the left, so that to pass one must pull the first open to the left, and then push the second open to the right. The two segments or doors overlap or cover each other, and are passed successively.

As the result of this elevation of the pubic segment, the bladder is drawn up above the pubes, and its peritoneum is stripped off.

The Connections between Bladder, Urethra, Uterus, and Rectum.—*a*. The posterior wall of the bladder is *loosely* attached to the anterior vaginal wall.

b. The urethra and anterior vaginal wall are closely blended.

c. The posterior vaginal wall and anterior rectal wall are *loosely* connected as far down as the apex of the perineal body.

Mutual Actions of the Pubic and Sacral Segments.—The sacral segment, strengthened at its tip by the perineum, is the supporting one; it holds the pubic segment. The anterior margin of the sacral segment stops short of the pubes by about an inch and a half, and this interspace is filled up by the pubic segment. Intra-abdominal pressure presses the pubic segment against the oblique sacral one, which closes the pelvic outlet, therefore, like a valve. Excessive intra-abdominal pressure displaces, in prolapsus uteri, a definite part of the pelvic floor in front of the anterior rectal wall.

The pelvic floor projection is a term used to express the bulging of the floor in the mesial line beyond the straight line joining the tip of the sacrum and the subpubic ligament. This is increased in pregnancy, and, of course, greatly in labor as the head advances. It is characteristically increased in retroversion of the gravid uterus.

The Peritoneum.—The relations of the peritoneum are of great importance in obstetrics. Starting from the anterior abdominal wall, the peritoneum is reflected a little above the symphysis pubis on to the fundus of the empty bladder; passes downwards over the posterior surface of the bladder, thence crosses on to the anterior surface of the uterus at a point about level with the os internum uteri. From this it passes over the anterior surface of the uterus, thus covering the body of this organ; it passes over the fundus, down the posterior surface, and still descending, covers the upper posterior vaginal wall for about an inch in the mesial line. It then rises to cover the anterior wall of the rectum.

The Peritoneum at the sides of the Uterus: the Broad Ligaments.—The peritoneum, which has enclosed the uterus back and front, passes off at each side, the anterior and posterior laminæ approaching to constitute a sheet-like membrane—the broad ligament. It presents three winglets on either side; the middle and upper one embraces the Fallopian tube, the posterior one covers the ovary, the anterior one covers the round ligament. Between the layers of the broad ligament lie connective tissue, unstriped muscle, bloodvessels, lymphatics, and nerves. The broad ligaments are continued to the sides of the pelvis, to which they are attached. The peritoneum thence lines the side-walls of the pelvis.

The broad ligaments, with the uterus in the middle, divide the pelvic

brim and excavation into two parts, anterior and posterior. In the anterior is

The utero-vesical pouch formed by the reflection of peritoneum from the bladder to the uterus. It is shallow, it holds no intestine, and fluids can hardly lodge in it, owing to the movements of uterus and bladder.

The utero-sacral or Douglas's pouch, is of far more importance. Its boundaries may be thus defined: First, the utero-sacral ligaments are the upper and lateral boundaries; its posterior boundary is the rectum and sacrum; the anterior boundary is the upper fourth of the vagina and the posterior wall of the uterus. But R. Barnes has shown[1] that the disposition of the pouch is not, as has hitherto been assumed, symmetrical or median. The dip is, in women who have not borne children, distinctly deeper on the left side. On the right side—that is, behind the right ovary and right broad ligament—the pouch is very shallow, sometimes scarcely an inch deep; it dips obliquely towards the left, descending behind the uterus and upper part of the vagina, and still dipping, it attains its greatest depth quite on the left of the uterine neck and vagina. Thus the sac is mainly situated behind the left broad ligament, being here often three inches or more deep. Douglas's pouch is the most dependent part of the great peritoneal cavity, and fluids and free solids gravitate into it, separating the walls which are naturally in contact.

When the uterus is lowered, attended by a corresponding degree of vaginal inversion, this pouch always goes along with it, so that in complete procidentia and inversion of the vagina the pouch will be external to the vulva behind.

Luschka described muscular fibres in the subperitoneal tissue of Douglas's folds, and styled them "musculi retractores uteri." They probably strengthen the peritoneum.

At the lower part of the pouch, which dips behind the vagina, the tissues between the fornix of the vagina and the peritoneum are scarcely one-third of an inch thick. This septum might be easily torn through by the finger, or forceps. It is sometimes chosen as the seat of incision for removal of the ovaries through the vagina. Solids or fluids getting into this pouch push the uterus forwards and downwards, compressing the bladder and urethra against the pubes. The retroflected uterus also lodges here.

Hart directs attention to the following facts about the peritoneum. When the bladder is distended the peritoneum is stripped off the lower part of the anterior abdominal wall to an extent varying with the distention. During parturition, also, the peritoneum is drawn off the bladder. Posteriorly, above the os internum uteri the pertoneum is closely blended with the uterus, and below this quite loosely.

Connective Tissue of the Pelvis.—This consists of the pelvic fascia and the loose connective tissue padding the interstices of the muscles, lying round the cervix uteri, and spreading out beneath the peritoneum. It has important bearings in childbirth and puerpery. In certain places connective tissue is gathered into masses or pads; in others it is distributed in laminæ or sheets. *One* such pad is found between the posterior aspect of the symphysis pubis and the angle formed by the urethra and anterior wall of the bladder—the retro-pubic fat deposit of Hart. A *second* mass is found between the base of the bladder and the anterior wall of the cervix uteri, but this is more dense. This mass, bounded by the peritoneal reflection above and the vaginal wall below, forms a firm bond between bladder and uterus, so that the uterus can hardly move without drawing the bladder

[1] Diseases of Women, 1878.

with it. A *third* mass is found between the lower posterior wall of Douglas's pouch and the related part of the rectum. A *fourth* mass is found in each ischio-rectal cavity. Uniting these masses, connective tissue runs along between the muscles and organs in layers of varying thickness. One portion, specially distinguished by Virchow as the parametric tissue, is a loose tissue 2 cm. thick, with abundant bloodvessels and lymphatics surrounding the lower portion of the uterus and the upper portion of the vagina. By others the term is intended to embrace all the connective tissue in the pelvis. R. Barnes describes this part of the connective tissue as of especial interest in labor. It is invariably stretched as the head advances, and hence is the seat of blood and serous effusions, commonly rapidly absorbed, but which may easily be the starting point of pathological processes.

The Continuity of the Pelvic Connective Tissue.—This character, of immense importance in the pathology of pelvic inflammation, is illustrated by dissection and by injections of air, water, and plaster of Paris. König and others have made experiments in this way. Bandl has summarized them thus: (1) Water injected between the layers of the broad ligament high up in front of the ovary passed first into the tissue lying at the highest part of the side-wall of the true pelvis. It then passed into the tissue of the iliac fossa, and lifting up the peritoneum, followed the course of the psoas, passing only slightly into the hollow of the iliac bone. Lastly, it separated the peritoneum from the anterior abdominal wall for some little distance above Poupart's ligament, and from the true pelvis below it. (2) On injection beneath the base of the broad ligament to the side and in front of the isthmus, the deep lateral tissue became filled first; then the peritoneum became lifted up from the anterior part of the cervix uteri. The separation passed thence first to the tissue near the bladder, and ultimately the fluid passed along the round ligament to the inguinal ring. There it separated the peritoneum along the line of Poupart's ligament, and passed into the iliac fossa. (3) An injection at the posterior part of the base of the broad ligament filled the corresponding tissue round Douglas's pouch, and then passed on as described at (1).

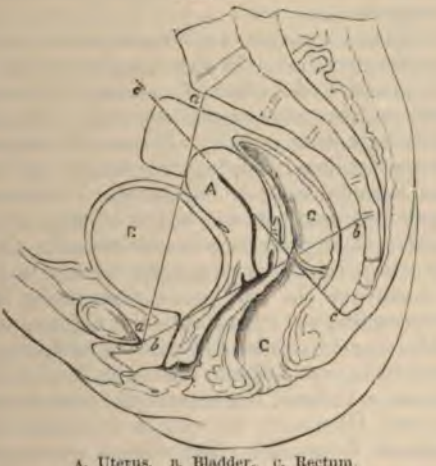
These experiments, it will be seen, run parallel in a great measure with the pathological observations on pelvic cellulitis and abscess, lending most valuable aid to the clinical appreciation of pelvic inflammations.

The Statics of the Uterus. What is the normal position of the uterus?—This is difficult to define. It varies much in different individuals, even apart from pathological influences. It is very mobile, slung as it were in the embrace of the broad ligaments, and very lightly tethered by the round and utero-sacral ligaments. It rests upon the bladder in front, and its union to this organ is its most fixed point; through it the cervical portion of the uterus is impeded somewhat from retreating backwards. When the uterine neck retreats, the base of the bladder must follow; so also in its ascent and descent. The movement of the body of the uterus is hardly at all impeded by this connection with the bladder. Thus Aran describes the utero-vesical bond as the axis of movement of the uterus R. Barnes gives a diagram ("Diseases of Women") to show that as the uterus descends in prolapsus, the cervical portion is held as if it were moored to the symphysis, whilst the body rolls back. Prolapsus, therefore, is almost necessarily attended by retroversion. Sections taken on frozen cadavers are not trustworthy evidence of the position of the pelvic organs. In life, the turgescence of the bloodvessels, the play of the muscles, and other vital conditions are all important factors. Clinical explorations, although seemingly less precise, give really better information. Generally, it may be said that the body of the uterus slightly curved forwards presents its fundus pointing in the axis

of the brim, or rather anteverted (see Fig. 56). A line (*a*, *a*,) drawn from the lower edge of the pubes to the sacral promontory will touch the summit of the fundus, so that the whole organ lies within the pelvic cavity. The os uteri externum will touch a line (*b*, *b*,) drawn from the lower edge of the pubes to the body of the fourth sacral vertebra. Frequently, however, the os will be found higher than this.

Inserted obliquely into the vagina, the uterus partakes of whatever support the vagina enjoys. The objections urged by some recent authors against the proposition that the uterus is supported by the vagina must not be accepted too readily. Hart, representing this view, contends that the uterus rests

FIG. 56.



A. Uterus. B. Bladder. C. Rectum.

upon the posterior or sacral segment of the pelvic floor, and owes nothing to the vagina. But the uterus often maintains its normal level when this sacral segment is virtually destroyed, as in complete laceration through the sphincter.

The vagina, in effect, is a musculo-elastic column which, when in moderate vigor, will easily support the uterus. The vaginal column, moreover, is supported by its attachments through connective tissue and fasciæ to the sides of the pelvis. The uterus may owe little to its ligaments; but still they contribute something. If, as one party contends, the ligaments are useless for this purpose, and if, as another party contends, the vagina is also useless, how is it that the uterus keeps its place against gravity and abdominal pressure when the perineum is destroyed? The uterus and anterior section of the floor of the pelvis move downwards on inspiration and forced expiratory effort, the chest being fixed, the glottis closed. On ordinary expiration the floor of the pelvis rises again towards the abdomen.

Physics of the Abdomen and Pelvis.

Certain points in the structure, contents, and properties of the abdomen call for notice.

DIMENSIONS OF THE ABDOMEN.—Bounded by the concave diaphragm above and the concave pelvis below, the average height is from 16 to 18 inches, or 40 cm. to 50 cm., or about one-quarter the body length. The capacity may be estimated from the weight of its contents. These weigh

together 12 to 15 lbs.=6 to 7 kilos.; their specific gravity is between 1.02 and 1.07. Making allowance for the hollow intestines, the capacity then is about 6 to 7 litres, or 12 to 15 pints (Spiegelberg). In gestation all the usual contents of the abdomen find room in it. In order to make space for the gravid uterus, the organs are packed away upwards and backwards; and still more room being wanted, the abdominal wall undergoes distention. In this way the capacity of the abdomen is increased. J. Y. Simpson estimated the capacity of the gravid uterus at 6 to 8 litres; but Tarnier says this is exaggerated, and places it at 4 to 5 litres—that is, at about 8 to 10 pints. We do not think Simpson's estimate much too high. Certainly in some cases it is exceeded. Whatever the quantity, it is nearly all in excess of the usual capacity. This must give an impressive idea of the changes wrought in gestation.

The Effect of Intra-abdominal Pressure on the Female Pelvic Floor has been studied by Hart. In the upright posture, assuming that the floor is under fluid pressure, the effect of ordinary intra-abdominal pressure is to press the pubic against the sacral segment. In ordinary conditions atmospheric pressure is acting equally all over the abdominal and pelvic surfaces; but the pelvic floor, bearing the weight of the viscera, bulges more than the other boundaries of the abdomen. If the woman be made to assume the genu-pectoral posture, the bulge of the viscera will be at the sternum, and the pelvic floor projection is diminished. So long as the vulva remains closed the two pelvic floor segments remain in contact. But if in the genu-pectoral posture or the semi-prone posture the labia be held apart and the perineum retracted, air rushes into the vagina, and the uterus, with the rest of the pubic segment, sinks towards the abdomen. This point was first explained, we believe, by Oldham, who submitted that by thus bringing the atmospheric pressure to bear, the retroverted uterus might be reduced.

Russell Simpson and Hart state the case in this way: "The segments of the pelvic floor separate from each other when a woman assumes the knee-elbow posture, and the hymeneal orifice is opened. The pubic segment passes down with the viscera; the sacral segment remains behind, recoiling slightly upwards. Thus, they say, *functionally the pubic segment is visceral, and the sacral segment is vertebral.*"

The Effect of Respiration upon the Abdominal and Pelvic Contents.—During inspiration the thoracic, abdominal, and pelvic cavities, *quoàd* pressure, become one cavity. The vacuum created in the chest forces down the lungs and diaphragm; these in turn drive down the contents of the abdomen and pelvis, causing projection of the pelvic floor. During expiration the reverse movement takes place. There is a general collapse of the chest and abdominal walls towards the centre; the pelvic floor ascends. This is clearly tested when the bladder is being emptied by catheter. During inspiration the stream of urine is stronger; during expiration it slackens. The ebb and flow of the urine is an exact gauge of the ebb and flow of the abdominal organs. Under this expiratory movement air may be drawn into the uterus, as in a case related by George Harley.[1] Under similar conditions, especially if seconded by the semi-prone posture, the heavy uterus, after labor, not supported by binder or abdominal muscles, bagging down creates a vacuum, and air is drawn into the uterus. Adolph Rasch[2] brought forward several illustrations of this law.

"There are interesting applications of this knowledge. It teaches that after labor, if not during labor also, and, in fact, in every case in which pelvic drainage is desirable, the best posture is the dorsal. It is by the semi-

[1] Obstetrical Transactions, 1863. [2] Ibid.

prone posture that we derive the greatest advantage from Sims's speculum. It greatly aids our efforts at reducing inversion of the uterus, and in replacing a prolapsed cord. On the other hand, in most operations upon the uterus and vagina, where it is of importance to bring the uterus as low down near the vulva as possible, the dorsal posture, by bringing the force of gravity to counteract the respiratory rise of the uterus, and which can be further greatly aided by direct pressure by the hand on the abdomen, is the best."[1]

The Pelvis as a Base of Support of the Trunk.—The pelvis may be looked upon as a bony belt composed of two vaults: the one upper and posterior, supporting the weight of the trunk at its median level; the other inferior and anterior, serving as a counter-arch to the first. These two vaults meet at their extremities, and at their point of junction are supported by the lower limbs. A transverse line passing through the centre of the heads of the femora represents the basis of support of the trunk and the axis of rotation of the pelvis. The weight of the trunk above bears first upon the sacrum and the sacro-iliac ligaments, tending to drive the sacrum inwards and downwards; secondly, is transmitted to the iliac bones, tending to compress them inwards towards the centre and downwards; thirdly, upon the cotyloid cavities and lower arch of the pelvis, where the down-pressure, being met by the resistance of the femora, tends to force the lower arch inwards and upwards towards the centre. All these tendencies are brought into clinical evidence in cases of osteomalacia, in which the softened bones yield to the lines of pressure.

Sometimes, as in some forms of scoliosis, the lumbar vertebræ yield under the superincumbent weight and sink forwards so as to overhang the pelvic cavity; or, as in disease of the sacro-lumbar joint, the last lumbar vertebra slips down dislocated from the sacrum into the pelvic cavity, a condition known as *spondylolisthesis*.

The *pelvis further acts as an organ of protection* to the structures contained within it.

The Measurements of the Pelvis.

Definition.—It is necessary to define precisely the points between which the measurements are taken. We adopt the rules laid down by Garson.[2]

The following are the dimensions of most practical use in obstetrics:

S. L. . . .	Length of the sacrum.
S. B. . . .	Breadth of the sacrum.
A. S. S. W. . . .	Width between anterior-superior spines of ilia.
C. W. . . .	Crest-width.
P. H. . . .	Pelvic height.
P. I. D. . . .	Pubo-ischiatic depth.
A. P. D. B. . . .	Antero-posterior diameter of brim.
T. D. B. . . .	Transverse diameter of brim.
A. P. D. O. . . .	Antero-posterior diameter of outlet.
T. D. O. . . .	Transverse diameter of outlet.
S. P. A. . . .	Subpubic angle.

The capitals give the initial letters of the dimensions. They are useful to save space.

The *sacral length*, S. L., measured from centre of upper margin of pro-

[1] Barnes's Diseases of Women, 1878.
[2] Transactions of International Medical Congress, 1881.

montory on body of first sacral vertebra to middle of inferior border of fifth sacral vertebra.

The *sacral breadth*, S. B., the maximum breadth of first sacral vertebra—*i. e.*, about the middle of its upper surface.

The width, A. S. S. W. (see above), from centre of the most prominent part of the posterior-superior spine of one ilium to corresponding point on the other.

P. I. D., the distance between the upper border of the pubes, measured from the smooth level surface on the pubic side of the iliopectineal suture and the lowest part of the tuber ischii.

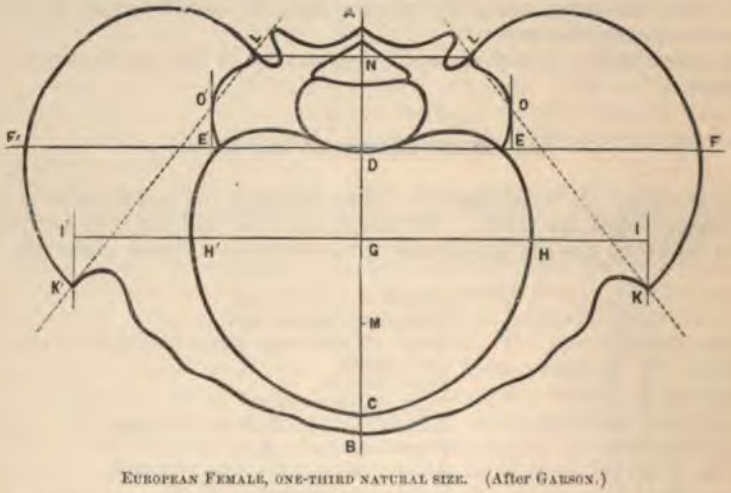
MEASUREMENTS OF THE BRIM.—The conjugate, A. P. D B., and transverse, T. D. B., are measured at right angles to one another; A. P. D. B. between the centre of the anterior-superior margin of the body of the first sacral vertebra and the most adjacent point of the linea symphysis pubis; T. D. B. across the widest part of the brim, which is usually a little above and anterior to the top of the great sacro-sciatic notch. Upon these two diameters, says Garson, the whole pelvis seems to be constructed.

OUTLET.—A. P. D. O., the distance between the centre of the anterior-inferior margin of the fifth sacral vertebra and the nearest point on the linea symphysis pubis.

T. D. O., width between the most widely separated points on lines passing parallel to the brim-line from the lower ends of the obturator foramina to the spines of the ischia.

THE SUBPUBIC ANGLE.—Formed by the meeting of the ischio-pubic rami of each side at the lower end of the symphysis pubis.

FIG. 57.



EUROPEAN FEMALE, ONE-THIRD NATURAL SIZE. (After GARSON.)

The relations of the measurements of the ilia and pelvic brim, according to Garson, allow of their being mathematically determined, and it is thus possible to construct a diagram from the measurements of an individual pelvis, or from the average measurements of any number of pelves. The European and Andamanese pelves (Figs. 57, 58) are drawn from the averages taken by him, and may be considered as typical forms. These are constructed upon the A. P. D. B.

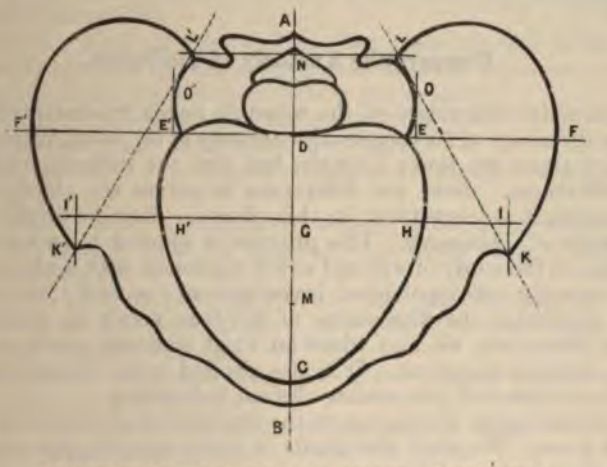
The mean variations of the A. P. D. B. and T. D. B. vary but slightly,

the T. D. B. less than the other. Garson, therefore, selects the T. D. B. as the index or standard measurement. T. D. B. is then 100.

Fig. 57, from Dr. Garson's memoir, is a diagram of a normal European female, constructed from typical index of transverse diameter.

Fig. 58 is a diagram constructed on the same plan of the Andamanese female pelvis.

FIG. 58.



ANDAMANESE FEMALE, ONE-THIRD NATURAL SIZE. (After GARSON.)

AVERAGE MEASUREMENTS OF THE PELVIS, IN MILLIMETRES (GARSON).

	S.L.	S.B.	A.S.S.W.	C.W.	P.H.	P.I.D.	A P.D.B.	T.D.B.	A P.D O.	T.D.O.	S.P.A.
14. European	101	118.3	231.5	271	201.7	91.4	106.6	133	116	115.9	76°
5. Australian	91.4	104.6	198.4	240.6	184.4	82.2	108.2	118.2	107.6	104.8	78°
13. Andamanese	91.4	97	172.1	207.7	167	76.4	99.1	102.8	100.6	93.1	85°
					Indices of the above measurements.						
14. European	75.3	88.7	173.8	205.8	151.8	68.4	80	100	87.2	87.2	...
5. Australian	77.1	89	167.8	204.1	158 9	69.5	92.4	100	91.5	98	...
13. Andamnese	88.5	94 2	167	201.9	162.1	73.8	96.2	100	98	90.2	...

The pelvis in man in all the races is distinguished from that of woman by several features. The differences between the different races are not less important. Anthropologists now seek in the comparison of the pelvis, as well as of the cranium, data for establishing a classification of the human races. Some day we may arrive at a scientific knowledge of the relations of the fœtal skull to the pelvis.

The most important researches in this direction are those of Vrolik (1826), Weber (1838), Barnard Davis, Karl Martin (1866), G. Fritsch, Flower, Verneau[1] (1879), Garson (1881).

Flower says that, "next to the skull, the pelvis appears to be the osseous framework most likely to afford distinctive race characters." Weber (1823) seeks to demonstrate that the head and the pelvis are subjected to the same laws of evolution; that the good or bad conformation of the one coincides with the similar state of the other. Hence, Weber says the inspection of

[1] Le Bassin dans les Sexes et dans les Races, 1875.

the head indicates the state of the pelvis. His method is very simple—the occipito-frontal, biparietal, and fronto-mastoidean represent the sacro-pubic, bis-iliac, and oblique diameters. The brim is in relation with the cranium, the face with the outlet.

It is worthy of notice that the A. P. D. O. is greater than the corresponding measurement of the inlet or brim in the Europeans, but smaller in the Andamanese; whilst in the Australians the two measurements are practically equal. The transverse diameter of the outlet is always smaller than that of the brim.

Comparative Anatomy of the Pelvis.

The distinctive characters of the woman's pelvis receive further illustration from the study of *the comparative anatomy of the pelvis*, including in this survey not alone the lower animals, but also the different races and the sexual differences. Since the differences in pelves are chiefly defined by measurements, it is convenient in this place to describe briefly the objects and methods of *Pelvimetry*. This practice is applied to two principal purposes—first, to the study of wet and dried specimens with a view to obtaining scientific data for anthropological investigations; secondly, for clinical purposes, to determine the dimensions of the true pelvis in woman, so that, possessing these data, we may educe an ideal standard pelvis as a basis for scientific obstetric argument. It is also applied to the living subject with a view to immediate and prospective clinical indications.

We will first apply Pelvimetry to the description of the pelvis in different races and sexes. We shall afterwards be better able to appreciate its application to the problem of labor.

Velpeau reminds us that Deventer and De la Motte even make no mention of geometrical measurements to determine the form or dimensions of the pelvis. It is dating from Ould and Levret that the expression of *diameter* found place in the domain of science. It was at first thought with Smellie that it was enough to indicate the sacro-pubic and bis-iliac diameters, but it was soon seen that the third or oblique was not less important; and Levret admitted it into the following editions of his work.

Pelvimeters for use on dried pelves admit of accurate construction and give precise results. For example, to measure the dimensions of the brim, cavity, and outlet, an instrument constructed on the plan of that used by hatters for measuring the inner dimensions of hats is perfectly applicable. But we cannot use such an instrument on the living subject. We must be content with approximate results, drawn partly from measurements, partly from calculation.

The Pelvis in Different Ages.—*The fœtal pelvis* resembles in general characters that of the brute. It is small in its transverse diameter compared with the antero-posterior. The parallelism of the lateral as well as of the anterior and posterior pelvic walls is, says Wood, sufficiently marked and general to be considered as a characteristic of the infant pelvis, as it is of most of the lower animals, giving to it a square-sidedness.

As childhood advances, the sacrum becomes more curved, and the transverse diameter widens. The sides of the pelvis grow until 19 or 20, so that, rightly, nubility is not reached until that age; but some subjects are developed much earlier.

The Differences between the Male and Female Pelvis.—It is not unimportant to take note of the points in which the female pelvis differs from the male. The general character of each is impressed by the functions for which it is framed. The male pelvis is built for strength, to support the trunk and

lower limbs, to give hold and leverage to the muscles and joints in the manner most favorable for powerful exertion. It is therefore compact and well ossified. The female pelvis is built with a view to the function of parturition. It is therefore capacious, and the bones are light in proportion.

The following are Verneau's principal conclusions:

1. The form of the superior circumference is the same in both sexes; the relation of the antero-posterior maximum diameter to the transverse maximum is in both sexes 0.62.

2. All the dimensions of the internal iliac fossa are less in the female, except the distance from the anterior-superior spine to the sacro-iliac joint.

3. The internal iliac fossa is more hollow in the male.

4. The iliac tuberosity is more developed in man.

5. The pubic spines are wider apart in woman.

6. All the diameters of the superior strait are wider in woman, especially the transverse.

7. The superior strait is rounder in woman, partly from its wider transverse diameter, partly from its transverse diameter being situated more anteriorly than in man.

8. In man the distance between the ischiatic spines is seldom *more* than 107 mm., and *often less* than 90 mm.; in woman it is often more than 107 mm., and *never less* than 90 mm.

9. The maximum transverse diameter of the inferior strait is nearly 15 mm. more in woman than in man.

10. The antero-posterior diameters of the inferior strait in woman are only a few mm. more than in man.

11. The pubic arch is wider in woman. (75° in woman, 58° in man.)

12. The summit of the pubic angle is always round in woman. The ischio-pubic tubercle is more turned outwards, and the ischio-pubic ramus is concave towards its middle part.

13. The cotyloid depression is smaller, and looks more inwards and backwards in woman.

14. The obturator foramen is relatively larger in woman, and more oblique outwards and downwards.

15. The distance between the ischia is greater in woman.

16. All the vertical diameters are greater in man.

17. The total height of the male pelvis is usually 220 mm.; the total height of the female pelvis is usually 197 mm.

18. The distance from the ischiatic spine to the anterior-superior iliac spine is usually in woman 137 mm.; in man 150 mm., which is never reached in the female.

19. The interval between the anterior-superior iliac spine and the lower part of the ischium is 165 mm. in woman; in man 182 mm., which is never reached in the female.

20. The relation between the maximum vertical and the maximum transverse diameters is only 0.74 in woman; in man it exceeds 0.79.

A characteristic feature is the eversion of the edges of the subpubic arch in woman. This facilitates the egress of the child's head. It adds to the capacity of the arch. The eversion is much less marked in the male pelvis.

The Pelvis in the Lower Animals.—The chief points of comparison are the following: Davis pointed out that *the oblique direction of the symphysis pubis*—it forms an angle of 35° to 40° with the horizon in the erect posture—is peculiar to the human species. In animals the symphysis is parallel with the axis of the body. In all the lower animals except the tortoise, the inlet and outlet of the pelvis are in a straight line. In woman, the pelvis forms

a curved canal. Both the *forward direction of the coccyx* and the *width of the pubic arch* are peculiar to the human species, and have reference to the erect posture. In all the lower animals, the transverse diameter of the pelvis is considerably less than the conjugate. Even the pelvis of the gorilla is striking by its elongated oval form.

The pelvis is not essentially a part of the parturient canal. No animal, Roberton observes, is endowed with a pelvis, unless it moves upon two or four limbs. The cetacea have no pelvis. Several species of quadruped mammalia either have an imperfect pelvis open in front, as the ant-eater, or so small that the vagina passes in front of it, as the mole, shrew, seal.

The man's pelvis approaches the type of the lower animals in this: the excess of the transverse diameter is more marked in the female; the increasing proportion of the transverse to the antero-posterior diameter may be accepted as the character which most constantly marks the rise in the scale of mammalia. In this respect man, the noblest ape, shows an advance upon the gorilla. Taking this as an index of progressive development, then we find the highest pelvic type in the European woman. Does this prove that man is the inferior animal? Man, perhaps, would appeal to another index —the cranium. If woman excels by the pelvis, man excels by the head. Do not the male and female features of excellence point alike to the influence which the reproductive organs exercise upon the development, not alone of parts of the skeleton, but of the whole organization of man and woman? If we commence from the earliest epoch in embryonic growth, we cannot help seeing abundant evidence of the dependence of structural development upon sexual determination.

Variations in the Pelvis in Individuals.—If variations in the form and size of the pelvis are less frequently observed than are variations in stature and other characters, this may be partly because the pelvis does not so readily lend itself to observation. It is, however, certain, that there is a considerable range of variations consistent with normal gestation and parturition. It is not easy to determine the relations which exist between the size of the pelvis and that of the whole body. We do not know that any precise observations upon this subject have been made. We may state from our experience that a large pelvis is not necessarily the appendage of a tall woman, nor that a short woman necessarily has a small pelvis. Small women not seldom have capacious pelves, and bring forth easily.

Hence the difficulty in determining a standard pelvis. This is no more easy than it is to determine the standard man. The standard of normal construction cannot be defined by a fixed number of inches. Elasticity within a certain range must be admitted. In some women the bones are thick, solid; the lines of muscular attachment are strongly marked. In others the bones are remarkable for lightness. The iliac fossa, the inclination of which forms, with the plane of the upper strait, an angle of 40° nearly, may be considerably more hollow or flatter, or more inclined to the horizon. The antero-superior iliac spines, generally directed towards each other by a scarcely perceptible curve, sometimes approach each other by an abrupt and decided curve, or diverge by turning outwards. The sacrum and pubic arch vary considerably.

Pelves may be distinguished as *large*, *medium*, and *small*. Text-books invariably describe a pelvis *æquabiliter justo major*, and a pelvis *æquabiliter justo minor*, meaning that in these cases respectively, without deformity, the pelvis is sensibly larger or sensibly smaller than the assumed standard.

The *pelvis is rarely quite symmetrical.* The right side is generally a little larger than the left. This is probably the result of the greater muscular development of the right side of the body. If from any cause one leg be

shorter or less used than the other, the corresponding pelvic half will be smaller (Paul Broca[1], R. Barnes[2]). It is probable that this greater development of the right pelvis may influence the frequency of right oblique positions of the head in labor.

The pelvis presents *planes*, *axes*, *curves*, *inclinations*, *diameters*, *angles*, *inclines*, and *circumferences*.

Planes of the Pelvis.—A plane is an imaginary level passing through the antero-posterior diameters and touching the sides of the true pelvis. For example, the plane of the upper strait or brim may be exactly represented by placing a sheet of paper cut to the shape of the brim upon the brim. *There are three principal planes*—(1) that of the *brim*, just described; (2) that of the *cavity*, taken in the centre of the pelvis, the front placed behind the middle of the symphysis pubis, the back in the centre of the sacral hollow; (3) that of the *outlet*, drawn from the tip of the coccyx to the edge of the pubic arch. Between these three cardinal planes any number of intermediate planes may be imagined.

A line falling perpendicularly upon each of these planes in succession would represent the curve of the pelvic canal, or its curvilinear axis.

The Axes of the Pelvis.—An axis of the pelvis is the perpendicular drawn upon a plane. Three axes may be adopted—that of the brim, of the outlet, and the curvilinear axis of the pelvic canal.

1. Thus, the Axis of the Brim is represented by a line perpendicular to the plane of the brim (*d*, *i*). Such a line produced to the umbilicus above, and continued below, would strike about the middle of the coccyx, the subject being erect. It coincides nearly with the axis of the uterus. This is the line the fœtus *nearly* follows to enter the pelvic cavity. It is usual to say *exactly* follows, but this R. Barnes has shown to be inaccurate, since the fœtal presenting part must roll round the promontory to get into the cavity, describing a curve backwards, sharp in proportion to the projection of the promontory. The axis of the brim is parallel with the inner face of the symphysis pubis.

2. The Axis of the Outlet is represented by a line perpendicularly falling upon the centre of the plane of the outlet (*h*, *k*). A perpendicular so drawn would—the coccyx being in its ordinary position—strike the sacro-vertebral angle. If the coccyx is extended as in retropulsion, the plane and axis of the outlet would both change with the retreat of the coccyx. This axis represents nearly the line taken by the fœtus in its exit.

3. The Axis of the Pelvic Canal.—This is the curved line resulting from the conversion of the axis of the brim into the axis of the outlet. If we look at the axes of the brim and outlet we see (Fig. 59) that they cross at an angle, obtuse pubeswards, about the middle of the pelvic cavity. If we continue the axis of the brim, keeping nearly in parallelism with the curve of the sacrum, this axis will strike successively all the planes of the cavity and emerge in coincidence with the axis of the outlet. This curved axis continued outside the pelvis round the symphysis as a centre will represent Carus's curve, the course taken by the head at birth.

The Planes and Axes in Different Attitudes.—These depend upon the *inclination* of the pelvis—that is, the angle formed by the plane of the brim with the horizon. In the erect posture, the plane of the brim forms an angle of 60° with the horizon. If the woman double herself up, crouching with the knees on the abdomen, the promontory will be lowered, and the anterior wall of the pelvis will be drawn up, the plane of the brim will become nearly horizontal, and the axis of the outlet will be inclined from

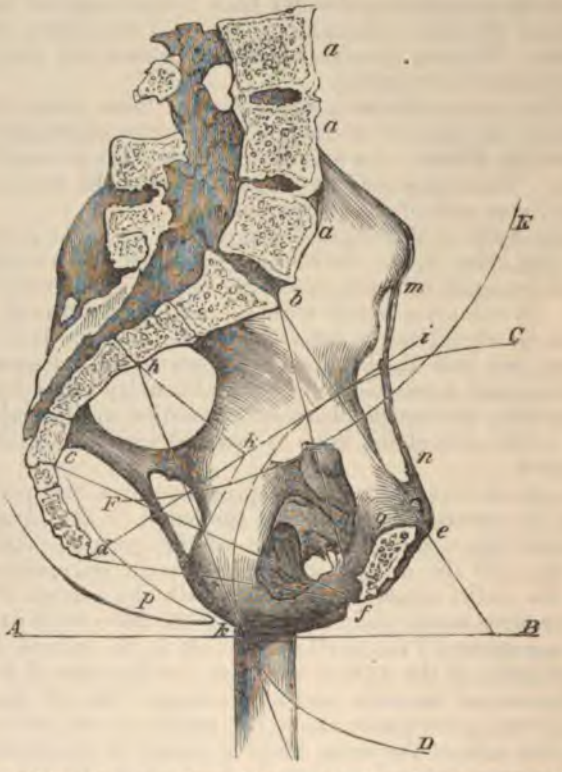
[1] Brown-Séquard's Journal. [2] Obstetrical Transactions.

behind forwards about 60°. The same thing occurs when the woma lying in a posture between dorsal decubitus and sitting.

Two Curves may be traced. They stand (1) in relation to the axis o inlet; (2) in relation to the axis of the outlet.

No. 1 we venture to call *Barnes's curve*. This is the segment of a c having for its centre the sacral promontory. (See Fig. 59, E, F.) U ordinary conditions—that is, with a well-formed pelvis, the promontory slightly projecting—this curve has no great clinical importance. But large proportion of cases, in which the promontory projects ever so l beyond the standard, and more and more as the pelvis assumes more dec

FIG. 59.



A, B. Horizontal, or datum line. C, D. Curve of Carus. E, F. Barnes's curve. *a*, *a*, *a*. Bodies of l vertebræ. *b*. Sacro-lumbar joint or promontory. *b*, *c*. Conjugate diameter of brim, and plane of *d*, *f*. Conjugate diameter of outlet, and plane of outlet. *g*. Symphysis pubis. *d*, *i*, Axis of brim. *h*, *k* of outlet. *m*, *n*. Poupart's ligament. *p*. Perineum.

contraction, as in most cases of rickets, and in the scoliotic pelvis this c cannot be disregarded. The head, which under the most favorable condit descends nearly straight in the axis of the brim, until the vertex touches floor of the pelvis, must describe a curve—the curve in question—round promontory in order to get into the hollow of the sacrum—that is, into pelvic cavity. Arrived here, to get out of the pelvis the head must desc a new circle, (2) *Carus's curve*, which has for its centre the symphysis pu This is the curvilinear axis already described. (See Fig. 59, C, D.)

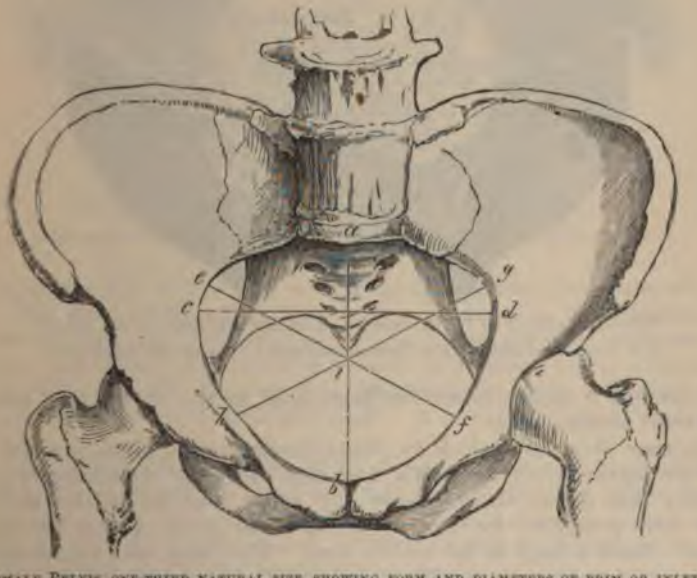
The Inclinations vary between the two extremes of the upright posture and of the doubled-up posture, knees upon the abdomen. (1) The *inclination* of the pelvis in *the upright posture* places the plane of the brim at an angle of 60° with the horizon. (2) The *inclination* in *the doubled-up posture* brings the plane of the brim nearly horizontal—that is, the axis of the brim is made to approach parallelism with the vertebral column. This inclination obviously facilitates the entry of the fœtus into the pelvis. Between the upright inclination of 60° and the horizontal of the doubled-up posture there are corresponding inclinations.

The change of inclination depends mainly upon the flexion or extension of the dorsal and lumbar vertebræ, and very slightly indeed upon flexion or extension of the sacrum upon the last lumbar vertebra.

In proportion to the degree of inclination, and the attendant prominence of the sacro-vertebral angle, will Barnes's curve be more or less pronounced.

The Diameters of the Pelvis.—The diameters have reference to the circles or circumferences of the pelvis taken at certain stated points of the pelvic canal. Thus there are diameters of the brim, of the cavity, and of the outlet. (1) The *diameters of the brim* are of first importance. In the majority of cases even of difficult labor, the relations of the dimensions and shape of the brim to the child's head determine the course of the labor.

FIG. 60.



FEMALE PELVIS, ONE-THIRD NATURAL SIZE, SHOWING FORM AND DIAMETERS OF BRIM OR INLET.

a, *b*. Antero-posterior or conjugate diameter. *c*, *d* Transverse diameter, *e*, *f*. Right oblique diameter. *g*, *h*. Left oblique diameter.

The proportions of the lower parts of the pelvic canal, although in many cases important, are in most cases of secondary importance to those of the brim. *Three principal diameters* must be studied. Fig. 60, *a*, *b*, the antero-posterior or conjugate; *c*, *d*, the transverse; *e*, *f*, *g*, *h*, the oblique. (See Garson's definitions of the diameters, p. 143, for indications of the points between which the diameters are taken.) The oblique, also called diagonal, diameter is double; the one measured from the right sacro-iliac joint, *e*, to

the opposite iliopectineal eminence is called the right oblique; and that drawn from the left sacro-iliac joint, *g*, is called the left oblique diameter.

It is convenient to set out the diameters of the three principal planes in a tabular form:

Diameters.	Brim.		Cavity.		Outlet.	
	Inches.	Centim.	Inches.	Centim.	Inches.	Centim.
Conjugate	4.30	= 10.70	5.25	= 13.20	4.25 or 5.25	= 10.70 or = 13.20
Transverse	5.30	= 13.00	5.00	= 12.70	4.75	= 12.00
Oblique or diagonal	5.00	= 12.70	5.25	= 13.20	4.75	= 12.00

Tracing the phases of the conjugate diameter through the pelvis, we see that at the brim it is the shortest diameter, and that it attains its maximum in the cavity and at the outlet.

The transverse is the longest diameter of the brim, medium in the cavity, and shortest at the outlet.

FIG. 61.

TRANSVERSE SECTION OF PELVIS, SHOWING SHAPE AND DIAMETERS OF THE CAVITY.

a, *a*. Conjugate diameter. *b*, *b*. Transverse diameter. The two are nearly equal.

The oblique is capacious at the brim, long in the cavity, and comparatively short at the outlet.

Supposing, then, an ovoid body, the circumference of which is about equal to the circumference of the pelvis, and that this body is moderately plastic, it follows that, driven on, this body will adapt itself in position and shape to the form presented by the unyielding canal at the planes successively reached. Such a body is the child's head. The head will, therefore, enter the brim in a transverse, or oblique diameter; having passed this strait, it will be compelled to turn its greatest length to the oblique and conjugate of the cavity; and still progressing, it will continue its rotation on its own axis, and turn its long diameter nearly to the conjugate or longest diameter of the outlet. We shall see hereafter the part that plasticity of the head plays in this problem.

If we trace the transverse diameters through the pelvis, we see that they diminish sensibly from above downwards; the transverse diameter at the

NOTE.—The dimensions given in the figures are not exactly those given in the table. They vary within normal limits.

brim being 5.3 inches, falling to 5 inches or less in the middle of the cavity, and to 4.75 inches or less at the outlet. The true pelvis, therefore, narrows as we approach the outlet, by the convergence of its sides. We have to note besides a small transverse diameter about the middle of the cavity passing from one sciatic spine to the other. It is a fixed diameter, and is smallest of all, measuring barely four inches. At this level, therefore, there is a kind of *middle strait*.

A *sacro-cotyloid diameter* is described. This is measured from the mid-point of the sacral promontory to the point behind the centre of the cotyloid

FIG. 62.

OUTLET OF PELVIS, SHOWING FORM, BOUNDARIES, AND DIAMETERS.

a, *a*. Antero-posterior diameter. *b*, *b*. Transverse. *c*, *c*, and *d*, *d*. The oblique diameters

cavity (*a*, *i*, *a*, *k*, Fig. 64). This, in well-formed pelves, gives from 3.5 to 4 inches. The most useful application of this diameter is to determine the characters of obliquely ovate pelves by comparing the two sacro-cotyloid diameters. Those who will take the trouble to measure pelves apparently normal in this way will discover how frequently one side of the pelvis—usually the right—is larger than the other. A perfectly symmetrical pelvis is very rare.

The *standard pelvis* is, of course, *an ideal pelvis*. This ideal is not obtained by striking the average of a large number of indiscriminate pelves, but of selected pelves. The best selection would be from pelves of women whose parturient capacity had been proved by their having gone through normal labors. In practice there is found a considerable range of pelvic proportions; and at least equally considerable is the range of size of the child's head. It is not uncommon to find pelves larger than the assumed standard.

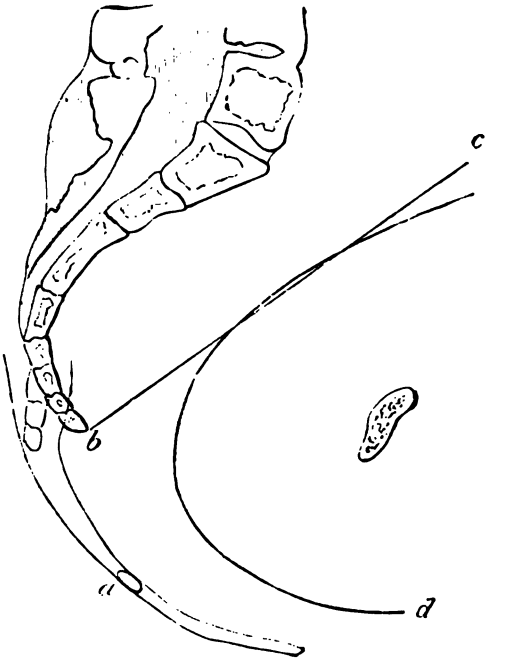
The **sacro-vertebral angle** is of the greatest obstetric interest. It is the cardinal point in labor. It is usually said to form an angle of 130° in woman. But many variations occur. We are familiar with pelves dry and in living subjects in which the angle is much more open, the promontory presenting a very moderate projection. The effacement of this angle is most marked in the kyphotic pelvis, in which the conjugate diameter is thus inordinately lengthened. But considerable flattening of the promontory sometimes occurs in pelves fairly proportioned. It is this angle which rules the

radius of Barnes's curve. Whenever the angle is less than 130° there is almost necessarily a proportionate increase in the depth of the sacral hollow.

The *sacral hollow* must be studied in relation to the sacrovertebral angle. This hollow may be estimated by drawing a line from the most projecting point of the promontory to the tip of the coccyx. The length of this line is one factor in the problem. A perpendicular drawn from the deepest part of the hollow to the line which subtends the arc will give the measure of the depth. The subtending line may be stated at 5 inches, the perpendicular at greatest depth at 1.25 inch. Observations of these data might furnish an index of the capacity of the sacral hollow.

If we suppose the sacrum to be flattened out, the length from promontory to tip of coccyx will be increased, and the perpendicular of greatest

FIG. 63.



SHOWING AXIS OF PELVIS AND CURVE OF PARTURIENT CANAL AS IT CHANGES UNDER RETROPULSION OF COCCYX AND BULGING OF PELVIC FLOOR, OR BARNES'S PERINEAL VALVE, IN LAST STAGE OF LABOR.

depth will be shorter. If, on the other hand, the sacrum be more curved, the promontory and tip of coccyx will be brought nearer together, and the perpendicular or depth will be increased. These relations have been too little studied, but clinical observation proves that the characters of the sacral hollow are of great practical importance. For example, an exaggerated hollow favors the production of occipito-posterior positions, and has a bearing upon the use of the forceps.

The *length of the anterior wall of the pelvis* is measured from the summit of the symphysis to the edge of the subpubic arch. This gives from 1.75 to 2 inches. We have known instances where this was much exceeded, giving rise to dyspareunia.

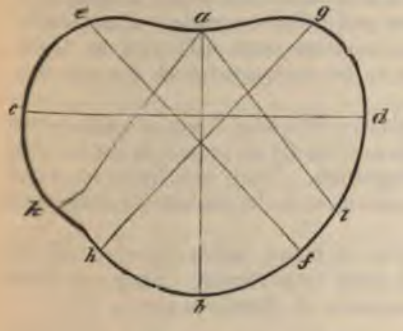
The length of the sides of the pelvis increases from the pubic symphysis as we proceed backwards.

Inclines.—The measurements from above downwards of the sacrum, sides, and symphysis represent so many *inclines*. The inclines of the sacrum have been sufficiently described. The *lateral inclines* require a little more attention.

We have seen that the transverse diameters converge from brim to outlet. The result of lateral convergence is to form inclines at the sides of the pelvic canal. There are two inclines on each side, separated by an oblique ridge running from the brim of the pelvis just behind the upper angle of the obturator foramen down to the sciatic spine.

The anterior incline is bony, resisting, and looks backwards, inwards, and upwards. The *posterior incline* looks forwards, inwards, and upwards. With

FIG. 64.



OUTLINE OF BRIM.

FIG. 65.

CAVITY.

FIG. 66.

OUTLET.

the exception of the sciatic spine, this incline is entirely composed of soft parts. It is made up of the anterior aspect of the great and lesser sacro-sciatic ligaments, the two sciatic foramina, and the muscles, vessels, and nerves which traverse them. Tyler Smith assigned to these inclines an important part in directing the rotation of the head. The views of this sagacious observer upon this point have not been generally accepted, but we are disposed to think them well grounded. If the head descend into the cavity with the occiput directed to either foramen ovale, it must be obvious that coming from the anterior incline, the ridge running along the posterior margin of the foramen to the sciatic spine will guide the occiput forwards

towards the symphysis pubis. The transverse diameter of the cavity narrowing downwards, the long diameter of the head must find accommodation by fitting itself to the space of least resistance, and this ridge will naturally guide the occiput forwards to the shallow part of the pelvis under the pubic arch.

The Circumference of the Pelvis.—We are for the present concerned with the true pelvis. Starting from the geometrical axiom that the circle is nearly three times the length of its diameter, we may approximately arrive at the circumference, say, of the brim by adding up its three diameters. Thus, 4.3 + 5.3 + 5 inches = 14.6 inches, or the circumference; for the cavity, 5.25 + 5 + 5.25 = 15.5; for the outlet, 5.25 (with coccygeal retropulsion) + 4.75 + 4.75 = 14.75 inches. These calculations very nearly correspond with actual circumferential measurements. (See Figs. 64, 65, and 66). They show clearly that the brim and outlet are really straits, and that the cavity expands between the upper and inferior straits. Practically we know that the passage of the head encounters most difficulty at these straits. These pelvic circumferences have to be contrasted with the circumferences of the fœtal head.

The External Measurements of the Pelvis.—We may limit our attention to those measurements which can be taken from fixed points in the living subject. The circumferences may be disregarded. They are liable to such variations from fat and muscular development as to be useless for obstetric purposes.

The following measurements, all capable of being taken between fixed points easily felt in most women, are of chief importance. They are best taken by means of the curved caliper compasses of Baudelocque:

	Inches.
1. External antero-posterior or conjugate diameter	7 to 8
2. External transverse between iliac crests	14 to 16
3. From great trochanter to opposite sacro-iliac joint	10 to 12
4. Depth of pelvis from top of sacrum to coccyx	4.5 to 6

THE RELATION BETWEEN THE EXTERNAL AND INTERNAL DIMENSIONS OF THE PELVIS.—The chief value of the external measurements depends upon their service as indications of the dimensions of the internal true pelvis. To what extent can they be trusted? If there were a definite and constant relation between the external and internal dimensions, it would be only necessary to determine this relation in order to possess an easy and certain clew to the great clinical problem, the dimensions of the true pelvis. Baudelocque and Velpeau deduct from No. 1, the external conjugate, 3 inches.

The case would stand thus: External conjugate = 7 — 3 = 4, the true conjugate. Unfortunately this calculation is utterly falsified in practice, more especially in cases of pelvic deformity—that is, in the very cases where information is most desired. Hohl says, from measurements made upon dry faulty pelves, the relation has often been quite normal; and that in most cases the true conjugate was 1 to 3 inches less than was indicated by the external conjugate. Measurements made by ourselves on dry pelves and in living subjects are quite in accordance with Hohl's statements.

Still, any marked diminution of the external standards may be trusted as giving an approximate idea of the state of the true pelvis. An unusually deep depression in the lumbo-sacral region, with straightening and jutting back of the body of the sacrum, is an almost sure sign of internal pelvic deformity; and unusual narrowness across the hips suggests a difficult labor.

The *bony pelvis may be explored at the following points of its external sur-*

face—namely, along the *crests of the ilia*, and especially at the *anterior-superior spinous processes;* sometimes along the *linea iliopectinea;* at the *symphysis pubis* from its upper border to the *subpubic arch;* the whole *spinous aspect of the sacrum and coccyx;* generally the posterior border of the ossa innominata; and below, the *tip of the coccyx* by the rectum, the *tuberosities of the ischia*, and the *ascending rami* of the ischia. In thin subjects all these points can be traced; in fat subjects all are more or less covered; but the symphysis pubis and the sacro-lumbar recess, the anterior-superior spinous processes, rarely escape careful examination under firm pressure.

These points serve as important landmarks to determine the relations of parts, and as points whence to measure the dimensions of the external pelvis.

Pelvimetry applied to Obstetric Practice.—If we could obtain approximately exact measurements of the dimensions of the pelvis in a gravid, especially a parturient woman, we should have solved one part of the great problem of obstetrics. If we could also take accurate measure of the dimensions of the fœtal head still in utero, and be at the same time able to estimate the degree of its plasticity, we should be in possession of the two primary factors absolutely and in their relations to each other. If, thirdly, we could accurately gauge the driving force brought to bear upon the first two factors, allowing for the resistance of the soft parts, we should almost realize the proposition of Levret, that "labor is a natural operation, truly mechanical, susceptible of geometrical demonstration." Unfortunately we have not arrived at this point. We have not yet mastered any of the component problems. How far, then, are we from the grasp of these component factors in their solidarity and their mutual relations!

Still, we must endeavor to solve each elementary problem as nearly as possible. If we could but overcome the first difficulty, that of obtaining precise knowledge of the pelvic dimensions, we might, assuming that the head was of standard proportions, be in most instances masters of the position; since it is in our power to lessen the resistance of the soft parts, to increase, to supplement, or to lessen the *driving force*, and to aid the moulding of the head.

How to Determine the Length of the Conjugate Diameter of the Brim.—The best pelvimeter for clinical use is the index finger. Before the head has engaged in the brim, it is always possible to reach the promontory with the finger by passing the hand into the vagina. The tip applied to the promontory, the side or back of the finger will rest against the pubic arch. This point of contact with the pubic arch may be marked off by the finger of the other hand. We thus have the length of the subpubic conjugate, or *lower or inclined conjugate.* (See Fig. 59, *b*, *f*.) This is estimated by Wood as about 0.5 in. less than the true conjugate. Thus, measured by the index, the inclined conjugate gives 4.5 in.; deduct 0.5 in., we obtain 4 in. for the true conjugate, the object sought. Pelvimeters have been constructed on the principle of the shoemaker's sliding-scale. One end of the rule is pushed up to rest on the promontory, whilst the sliding-rod is carried forward so as to rest against the inner surface of the pubic symphysis. This is the principle of Coutouly's pelvimeter. This would give the true conjugate. Various other contrivances have been adopted. We do not describe them because of the difficulty in using them and the imperfect results yielded by them. The skilful obstetrist always falls back at last upon his hand. It is not enough to know the length of the conjugate, and this is the only dimension within the purview of mechanical pelvimeters. The hand explores the whole region. Under anæsthesia it is not difficult to pass the hand into the vagina. The tip of the index thus is applied to the promontory; the thumb rests upon the inner surf of the

pubes, and takes an estimate of the conjugate; the finger then sweeps round the pelvic brim, noting the depth of the recess on either side of the sacrum, the width of the pelvis; and if the child's head is presenting, he takes note of the relation of the head-globe to the circumference of the brim as well as to the promontory. He traces the circumference of a ring—the brim—and weighs in his mind the probability of a plastic ball—the child's head—resting upon the ring, passing through it, allowing for moulding, spontaneous or by aid of forceps. This knowledge, approximate though it be, and only to be acquired by considerable experience, is what no instrument can give.

It may be stated as a general rule, as a rough but valuable indication, that if the promontory be easily felt by the index passed into the vagina, the presumption that the conjugate is contracted is strong. This is confirmed if we find the sacrum externally very flat, or excessively curved, the coccyx pointing unduly forwards.

We have already discussed the relations between the external and the internal dimensions as indicating the length of the internal dimensions. Alone, they cannot be trusted, Taken together with internal examination, they may yield useful controlling or corroborative data.

For the purposes of scientific study, and with a view to the treatment in future pregnancies of the woman under observation, pelvimetry may be usefully supplemented by careful measurements of the child's head after birth, noting at the same time the degree and kind of plastic deformation undergone.

The Breasts.

The breasts (*μαστός*, from *μαστεύω*, to seek, because the infant seeks in them the milk) are glandular organs associated with the organs of generation, designed to support the child during the first months after birth. The breasts belong to the skin, of which they may be considered to be dependencies. They pour out their secretion directly on the external surface of the skin. The important function fulfilled by the breasts has led zoölogists to class all animals possessing these organs in the same class under the name of mammifera. One character proper to this class is that all are viviparous—that is, all give birth to young which are born free from their fœtal envelopes.

The breasts exist in both sexes; but are rudimentary or atrophied in the male. They belong essentially to the female, and are not completely developed until the epoch of puberty. They are two in number in the human species, which is uniparous; generally amongst animals they are double the number of the young brought forth. Examples of triple or quadruple breasts in women are very rare; and sometimes the supernumerary breasts are more apparent than real, consisting of simple nipples or of masses of adipose tissue.

The breasts occupy the anterior and superior part of the chest, which, spreading transversely, affords a favorable condition for the development of the organs, and, says Plutarch, in order that the mother may embrace and hold up her infant whilst giving it suck. In animals whose young suck standing or squatting on the ground, the breasts are situated on the abdominal region.

The breasts are developed in proportion to the growth of the genital organs; they increase in volume during pregnancy, and especially after delivery, and become atrophied in old age. Their size does not always correspond with the stature, strength, or constitution, and it is not uncommon to find delicate, phthisical women with very large breasts. But certain families, and especially races, present remarkable varieties. In certain

African races—partly, perhaps, as the result of particular manipulations—the breasts are so long as to hang down as far as the groins, or, hanging over the shoulders, even permit the infants to suckle whilst being carried on their mothers' backs.

In judging of the size of the breast, care must be taken not to confound what properly belongs to the gland with that which depends upon fat. The largest apparent breasts are not always those which supply the most milk; in such the true glandular structure may be inconsiderable.

The free or cutaneous surface of the breast is convex, of a dull white, smooth, soft to the touch, and often covered with very fine hairs. Around the nipple is a well-defined circle called the *areola*. The tint depends upon the complexion—thus it is pale-rose in the fair, and dark in brunettes. In both the tint deepens in gestation. The areola presents a rough aspect, which is especially manifest during gestation. This appearance is due to a multitude of sebaceous glands, and principally to special glands, from five to fifteen in number, arranged in a circular manner around the base of the nipple, or dispersed irregularly over the space of the areola, and projecting a little on the surface. These are the *tubercles of Morgagni*. In some women, in addition to the sebaceous glands, there are found some hair-follicles in the areola. The diameter of the areola is from 3 to 5 centimetres (1.25–2 in.).

The *nipple*, slightly directed outwards and downwards, commonly answers to the fourth intercostal space. It is colored rosy or brown, excepting at the summit, which remains pale; it is rough, as if fissured on its summit, and susceptible of a kind of erection. Sometimes it is cylindrical, sometimes conoid, and sometimes it is so short, flattened, or even buried in the substance of the breast, that it is impossible for the infant to seize it. The surface of the nipple is uneven, and covered with large, closely set papillæ, conical or nipple-like; many of these papillæ present secondary papillæ, which, however, form no relief on the surface of the epidermis, but each contains a vascular loop. Between the large papillæ the small sebaceous glands open by microscopical orifices. At the summit of the nipple are seen depressions in which the galactophorous ducts open by a variable number of orifices.

Structure of the Breast.—The breast is composed of an envelope of skin, of a layer of adipose tissue, and of the mammary gland. All these parts are united together by a very resisting connective tissue.

The skin covering the peripheral portion of the breast presents nothing remarkable. But at the level of the areola it shows peculiar characters: in addition to the extreme thinness of its epidermis, it is remarkable for a great accumulation of pigment in the deep strata of its mucous element, for the great number of sebaceous and sudoriparous glands, for the hair-follicles, rudimentary in woman, often much developed in man, and lastly for the glands which, projecting on the surface, constitute the tubercles of Morgagni. These glands, which are rarely absent, are developed during gestation in the same proportion as the mammary gland. They are small clustered glands, composed of several irregular lobules, which themselves are formed of glandular vesicles. They give rise to a small excretory canal, which opens at the summit of the tubercles of the areola, and supply a liquid possessing all the characters of milk. Beneath the skin of the areola there is a layer of smooth muscular fibres; these are arranged in concentric circles around the nipple, which become more numerous and more thickly disposed of as they approach the nipple. Besides these annular fibres, there exist, according to Meyerholtz, radiated fibres, which arise from the skin of the areola, in the neighborhood of the nipple, converge towards this organ, and meet in the cellular tissue underneath it, forming species of arcs with the concavity

turned towards the skin. These fibres contracting, increase the projection of the nipple.

The skin of the nipple is fine and pigmented, except at the summit, and is intimately adherent by its deep surface to the subjacent parts. Very numerous sebaceous glands are attached to this tegument and open directly on its surface, which is deprived of hairs. Beneath the skin are found the galactophorous canals, fifteen to twenty in number, united into a bundle, and occupying the axis of the nipple. In the child and adult man they are very small; in woman they measure from 0.4 mm. to 1 mm. in diameter, and two layers can be distinguished in their walls; the one, external, is formed of connective tissue; the other, internal, is folded longitudinally and composed of an amorphous membrane enclosing elastic network, and of a pavement epithelium, stratified near the orifices of the nipple, cylindrical further in.

Just beneath the nipple the milk-ducts expand and form ampullæ or reservoirs—the *sinus ductum lactiferorum*. They may attain a diameter of 5 to 8 mm. when filled with milk; they then take a winding course and have an irregular bulging appearance (see Fig. 67, 7). The walls of these larger ducts consist of connective tissue in which is enclosed a dense layer of ring-shaped elastic fibres.

1. *The muscular fibres* of the nipple surround the galactophorous canals, crossing each other in all directions. Some are parallel to the surface of the gland; they form a kind of trelliswork, through which pass the canals; some fibres are parallel to the axis of the nipple.

2. *The Adipose Tissue.*—The breast is, in fact, a dependency of the skin, for it is lodged in the subcutaneous adipose tissue; and more than this, the adipose tissue penetrates into the substance of the mammary gland, dividing it into small masses, and in very stout persons it appears even to insinuate itself between the glandular grains.

The depressions or cups presented on the outer surface of the breast are filled with masses of adipose tissue, separated by fibrous lamellæ stretching from the mammary gland to the skin (Fig. 67, 5, 5). The fibrous spaces which contain these adipose masses do not communicate with each other, a circumstance which explains the frequency of circumscribed inflammations and abscesses of the breast. The development of the adipose tissue and of the mammary gland stand in inverse ratio to each other.

3. *The Mammary Gland.*—Freed from the fat in the midst of which it is buried, the mammary gland is seen as a mass flattened from before backwards, thicker in the centre than at the circumference, which is unequally notched. Its base, which is plane and even slightly concave, rests upon the great pectoral, and sometimes externally upon the serratus magnus muscles. A fibrous layer continuous with the superficial fascia and enclosing large bundles of elastic fibres separates it from these muscles, to which it only adheres by a very lax serous cellular tissue, imparting to the organ a great freedom of motion.

The cutaneous aspect of the mammary gland is very unequal, hollowed into pits separated by crested prolongations. (See Fig. 67, 4, 4.) These pits are filled up with adipose tissue which conceal the irregularities of the surface. The proper tissue of the gland is denser than the greater number of glandular organs. It should be studied apart from and during lactation. In the first condition it presents the appearance of a very compact fibrous tissue, of a whitish color, divided into unequal lobules, very much resembling certain tumors of the uterus. The granular disposition proper to the tissue of glands does not exist in an obvious manner. In fact, when the finer ramifications of the galactophorous canals are traced in children of both

sexes, it is found that they terminate in swollen *culs-de-sac*. At puberty, small vesicles are grouped around these *culs-de-sac;* these vesicles are enveloped in a layer of cellular tissue, enclosing a multitude of elongated nuclei, whose great axis is parallel with the canaliculi. It is at this point that the development of the breast in the male sex is usually arrested, and

FIG. 67.

SAGITTAL SECTION OF A BREAST OF A PUERPERA. (After HENLE.)

1. Skin. 2. Panniculus adiposus. 3. Body of mamma. 4, 4. Crest-like projections of mamma. 5, 5. Fat-masses between the crests. 6. Milk-ducts of the nipple. 7. Sinus of milk-ducts filled with milk. 8, 8. Section of milk-ducts in centre of mamma, surrounded by glandular tissue.

becomes atrophied. In woman the development proceeds, the ramifications become more numerous and finer, stretch to the periphery of the gland, and are furnished with a multitude of vesicles.

During lactation the granular disposition becomes especially evident. The glandular grains, which measure from 1 to 2 mm. in diameter, s

into small groups or flattened lobules superposed on each other. From each little group proceeds an excretory duct, recognizable by its white color; it is easy to inject, and results from the reunion of a number of radicles proportional to the number of glandular grains. Cruveilhier says that, having had the opportunity of dissecting the breast of a woman recently delivered, in which the cellular tissue uniting the glandular grains was infiltrated with serosity, he found the grains dissected, as it were, by this infiltration; the galactophorous ducts were injected with a yellow coagulated milk. He thus saw that some of the glandular grains were isolated, and as if pedunculated, whilst others were agglomerated into regular or irregular groups; one of these groups was disposed in a circle, and from all the grains of this circle issued small excretory ducts, directed from the circumference to the centre like radii, and terminated in a common excretory duct, which went from the central point. Other groups were elongated. At the centre was a galactophorous duct receiving the small excretory radicles proceeding from each

FIG. 68.

SECTION OF THE GLANDULAR SUBSTANCE OF THE MAMMA. (After HENLE.)
* Terminal branch of a milk-duct. * * Connective tissue stroma.

granulation. Each grain had a central cavity, from which a worm-like substance formed of coagulated caseous matter could be squeezed. These grains were composed of vesicles analogous to the salivary glands.

This transformation of the glandular tissue begins at the periphery of the organ, and in the kind of crests which rise on the surface. These crests become broader, flatter; the deep aspect of the breast assumes a granular appearance. At the same time, the gland loses consistency and assumes a yellow color. The glandular vesicles are composed of an investing membrane extremely thin, and contain globules of fat resembling those of the milk. (See Fig. 69, *a*.) This fatty matter is dissolved by the aid of soda; the wall of the vesicle is seen covered with a layer of epithelial cells. Independently of the granulations there enters into the tissue of the gland a large quantity of fibrous tissue, which, after having formed a complete investment, sends into its substance processes more or less lax which hold together the lobules. It is to this large proportion of fibrous tissue that the gland owes its hardness. Sometimes the development experienced by the breast bears exclusively upon the fibrous element, and then it may acquire an enormous size; sometimes the glandular structure disappears, and the breast is transformed into a multilobular fibrous mass which has been sometimes taken for a degenerate lipoma.

The Galactophorous Ducts.—If the breast of a woman who has died during lactation be divided, milk oozes up from a multitude of small points, as if from the pores of a sponge. These are sections of the lacteal or galactophorous ducts. These arise from the granulations as already described, and are gathered into an indefinite number of principal ducts terminating at the centre of the mammary gland at the level of the areola. Here they attain their greatest size, and form dilatations leaving no interspaces. The number of these dilatations (*reservoirs* or *sinuses* of the galactophorous canals) varies from ten to twenty. They are of unequal size; at the base of the nipple the canals narrow, become straight and proceed parallel to each other, to open at the summit of the nipple by orifices much smaller than the canal themselves, (See Figs. 67, 69.)

Fig. 69.

(After Cloquet)

a, a. Lobules of acini or glandules. *b, b.* Canals. *c.* Sinus of milk-ducts. *d.* Nipple in which milk-ducts terminate.

Thus, although there exists no distinct reservoir for the mammary gland, it may be considered that these dilatations fulfil the function of reservoirs. There is this difference, that instead of the single reservoir of other glands, there exist in the mammary gland multiple reservoirs.

The galactophorous ducts nowhere communicate with each other. The mammary gland, like most other glands, is divided into a certain number of distinct departments which may execute their functions independently of each other. Hence it is that diseased breasts may supply milk possessing all the normal characters. Injections show that the ducts have no valves. Fig. 69 gives a general idea of the arrangement of glands, canaliculi, ducts, sinuses, and their terminations in the nipple.

Vessels.—The *arteries* come from the thoracic, especially from the external mammary; from the intercostals, and from the internal mammary. The branches supplied by the internal mammary and the intercostals attain a considerable size during lactation. When thus hypertrophied they become flexuous.

The *veins* are very largely developed, and are divided into two orders: subcutaneous and deep. The latter accompany the arteries. The former are seen through the skin and form under the areola often incomplete, called the *venous circle of Haller*.

The *lymphatics* are very numerous; some are superficial, some deep. The first arise from the cutaneous networks, exceedingly delicate and very abundant, which cover the nipple, the areola, and its neighborhood; they proceed to the axillary ganglia. The deep lymphatics proceed from the glandular lobules, and all run towards the axilla; there they form a plexus, composed of large vessels, whence run several trunks which also terminate in the ganglions of the axilla.

The *nerves* come from the intercostals and the thoracic branches of the brachial plexus.

DEVELOPMENT.—The mammæ become apparent from the third month. Langer and Kölliker show that they are represented at their origin by a warty excrescence of the mucous body of the epidermis. From the sixth to the seventh month a number of pyriform buds, the rudiments of the lobes of the glands, appear on the surface of this excrescence; but it is only towards the end of fœtal life that these buds become isolated from each other, and open outwards. At *birth* the mamma is already composed of distinct lobes, each having an excretory duct. But before puberty no true glandular vesicles are found; until this epoch the mamma differs in the two sexes only in the greater size of the nipple, and a somewhat greater size of the gland in the female child.

At *puberty* the mamma acquires gradually its destined size. Its development coincides with that of the genital organs. The glandular vesicles show themselves at this time, but do not assume their full development before the first pregnancy. At the same time remarkable modifications

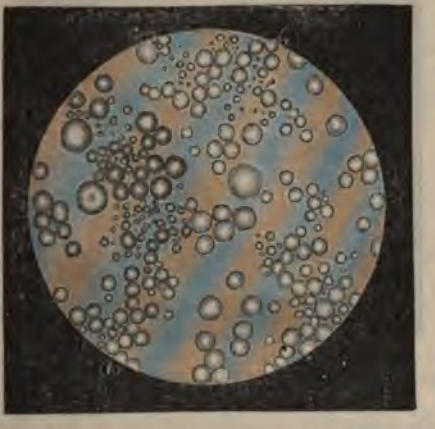
FIG. 70.

SHOWING COLOSTRUM AND ORDINARY MILK GLOBULES, FIRST DAY AFTER LABOR, PRIMIPARA AGED 19. (After HASSALL.)

take place in the epithelial cells which line these vesicles, whence results the secretion of milk. Globules of fat, the quantity of which increases more and more, accumulate in the epithelial cells, which having grown bigger, end by completely filling the cavity of the glandular vesicles. At the same time, new vesicles are formed near the walls of these last, which by their development push the old ones into the excretory canal. There they accumulate and partly destroy each other, in order to be expelled externally during the first days after parturition with the yellowish liquid which bears the name of *colostrum* (see Fig. 70). After labor the production of cells in

the glandular vesicles assumes an extraordinary activity; these cells, filled with fat-globules, disappear altogether in the galactophorous ducts, since no trace of their investing membrane is seen in the milk. There is found nothing but a multitude of rounded corpuscles, shining, of fatty nature, held in suspension by a plasma which contains in solution casein, sugar of milk, and a variable quantity of inorganic salts. Thus constituted, the *milk* forms a liquid of an opaline white, of a sweet and sugary taste, and combining all the essentials of a perfect nutriment.

FIG. 71.



GLOBULES OF HEALTHY MILK; FOURTEEN MONTHS' LACTATION.

The breasts become atrophied in old age, the vesicles disappear, and sometimes nothing but a little fibrous tissue is found in their place.

During the period of secretion the breasts receive a much larger supply of blood than at other times. Pregnancy favors the development of the secreting portions of the glands, but does not induce secretion. On the other hand, when pregnancy occurs during lactation, it diminishes, modifies, and may arrest the secretion of milk.

The secretion of milk is nearly continuous. When fully established, whilst there may be certain periods when it is formed in greater quantity, there is no absolute intermittency.

When the milk-ducts are filled to the utmost, before the overflow begins, there must exist an apparatus to keep the mouths of the ducts closed, and which will only give way under greater pressure. Such an apparatus is provided in the musculature of the papillæ. The ducts, whose calibre within the nipple is already smaller than before entering the nipple, look narrower still when compressed by the muscles between which they run.

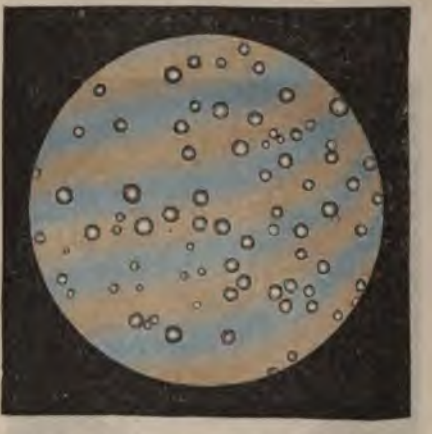
The secretion of milk is undoubtedly stimulated by emotional excitement, and by reflex irritation. Thus the mother, thinking of her child, feels "the rush of milk" to the breasts; they quickly enlarge, and milk flows; and the touch of the child sucking the nipple by mouth or hand acts partly by emotional influence and partly by reflex influence. We may see this in lower animals. The calf seeking milk tosses its mouth against the mother's breast, and thus increases the flow by gentle succussions. Under this excitement the sphincteric muscles relax, and the milk escapes.

The milk accumulates to the point of compelling relief at intervals varying according to the health of the individual and her habit. Generally the mother feels this want about every four to six hours.

Terror, grief, shock, any violent emotion, may suddenly suppress the secretion. Astley Cooper relates two cases.

After eight or nine months' lactation, the milk frequently becomes "poor." This condition admits of close appreciation by the microscope; the globules are small and scattered. (See Fig. 72.)

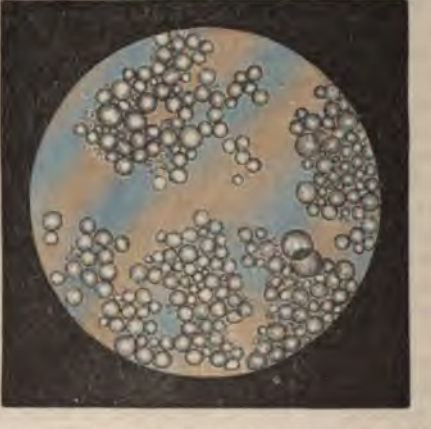
FIG. 72.



IMPOVERISHED MILK; SCANTY GLOBULES. (After HASSALL.)

When there is engorgement or inflammation of the breasts, healthy milk may still be secreted for a time, the chief seat of inflammation being the connective tissue. But often the globules become agglomerated. (See Fig. 73.)

FIG. 73.



MILK-GLOBULES AGGREGATED, AS IN ENGORGEMENT OF THE BREASTS. (After HASSALL.)

In cases where menstruation returns, the secretion of milk is commonly checked. In some cases (Robert Barnes) there is a monthly reappearance of colostrum-globules coincident with menstruation.

The breasts maintain intimate functional relations with the uterus and

ovaries. During menstruation and gestation they feel the impulse and become turgid and tender. Sexual excitement sometimes starts from sensations in the breasts arising spontaneously or provoked by touch. At these times the breasts become turgid, firmer, and the nipples stiff and erect. After labor, irritation of the nipples, as by the child sucking, or other modes of milk-aspiration, will cause the uterus to contract. This is turned to account to control post-partum hemorrhage, One of the great uses of lactation is to promote contraction and involution of the uterus. Women who do not suckle are especially liable to subinvolution. On the other hand, we have known slight hemorrhage occur whenever the child was put to the breast. It is a common event for women to feel uterine spasm or colic when the child seizes the nipple.

There is a struggle between the ovary and the breast for supremacy. In the end the ovary is pretty sure to win and to put an end to lactation. On the other hand, persistent lactation will occasionally suppress menstruation and postpone conception for several years. We have notes of cases in which menstruation was thus kept in abeyance for five years. One woman had become a widow, so that all her feelings and functional work were concentrated upon her child. But in other cases the woman continued to live with her husband, and had no child to suckle.

ABNORMALITIES.—These consist chiefly in multiplicity and unusual situations.

Robert, of Marseilles, reports in Magendie's "Journal of Physiology" the case of a woman who had a well-formed mammary gland on the outside of the left thigh. The mammary glands upon the chest performed their function with regularity, and were normal in all respects; but the gland upon the thigh secreted during lactation such a quantity of milk, that the woman had nourished all her children, seven in number, indifferently from the three glands. The mother of this woman had three mammary glands, one on the left side of the chest and two on the right. This case is perfectly authentic, and was reported on by Chaussier and Magendie.

In Dunglison's "Human Physiology" (1856) numerous very curious instances of unusual lactation are recorded.

Fancourt Barnes saw a woman in St. Thomas's Hospital who had four breasts. There were two in the usual places on her chest, and two additional ones on her abdomen, one on either side of the navel.

CHAPTER VII.

THE PROCESSES OF GESTATION, CHILDBED, AND LACTATION.

CONSTITUTING parts of one great function, Reproduction, the processes of gestation, childbed, and lactation must be studied in continuity, in their togetherhood, and in their relation to each other. It is true that this great function may not be completed—that is, the stage of lactation may not be reached; childbed, strictly speaking, may not be reached; and the right period of gestation may not be fulfilled. Still, the function of reproduction is in its essence one, and the conditions for its complete performance always exist, at least potentially or in design. Childbed is the necessary supplement to gestation, and forms the transition stage between gestation and lactation —the complement or culmination of the function. A special organ holds predominance at each stage of the function. During gestation the uterus, obeying the developmental impulse of the embryo, is the ruling centre of nutrition and of influence upon the nervous system. In a typical case the transition stage of childbed merges quickly and easily into that of lactation. The breasts, prepared beforehand for the work, enter upon duty almost at once. The new-born infant has not long quitted its nidus in the uterus before it seeks a new source of supply. It seizes the breast, and, its developmental force now acting upon this organ, makes it the dominating centre.

Looking beyond, that is, before and after the processes of gestation and lactation, Tyler Smith set forth the history of reproduction in the happiest manner. He summed it up in the description of the Genesial Cycle. In the ordinary state the active or dominating organ of the sexual system is the ovary. The reign of this organ is expressed by menstruation, the part taken by the uterus in this process being secondary, or in obedience to the impulse of the ovary. The ovary reigns supreme until conception takes place; then the uterus succeeds, and rules until the child leaves it. Then it is deposed, and yields its place to the breast. The breast rules with more or less authority until it is supplanted by the ovary, which is ever struggling for supremacy, and cannot long be kept in subjection.

These organs, the ovary, uterus, and breast, are the agents in carrying out the imperious law of reproduction. To this law they are alike subservient. Throughout the genesial life of woman there is a continual series of efforts to accomplish this purpose. Every menstrual act represents the ripening of an ovum, and its reception into the Fallopian tube and uterus ready for impregnation. It is an attempted pregnancy. The ovum is there, the nest is prepared, the breasts feel the nisus; but for want of the fertilizing element the process is abortive.

The analogy between menstruation and pregnancy and labor is traceable in detail. A sketch of the menstrual process is a necessary introduction to the history of gestation. The *primum mobile* in either case resides in the ovary. The first step is ovulation, or the ripening of an ovum, and the depositing it in the uterus. But the work of preparation begins in the uterus long before the extrusion of the ovum from the ovary. In response to the development of the ovum, nerve-force and blood are attracted to the uterus, the whole organ swells, becomes heavier and more sensitive, softer from the permeation of its walls by fluid; the utricular glands of its cavity enlarge,

secrete more freely; the mucous membrane swells, grows, is developed into a thick, soft, pulpy membrane, the decidua. This process is the representative of pregnancy. It is marked by certain signs, more or less distinct in different cases. But in all there may be observed exalted nerve-tension, expressed by greater emotional and reflex mobility, sometimes revealed in neuralgia, in vomiting, and even in convulsion. There is increased central nervous irritability, and there is the eccentric source of irritation in the uterus. Concurrently with this increased nervous energy there is observed a marked increase of vascular tension. The pelvic vascular region especially feels the attractive force of the uterus, and the kidneys work more freely.

Then there comes the casting-off and casting-out of the useless decidua; the process is traumatic. This is the analogue of labor. The developed muscular fibre contracts under the influence of the intensified diastaltic function. Hemorrhage attends. The mimic labor over, the blood-current and nervous energy are diverted from the pelvis, and for a time the ordinary equilibrium of the economy is restored. The uterus returns to its wonted state, and the breasts become quiescent. Compare this sketch with the succeeding history of pregnancy, and points of similitude will be discovered at every stage.

The Natural History of the Process of Gestation.

We may now pursue the history of gestation. This may be said to begin after a menstruation or missed pregnancy. The phenomena of insemination, fertilization, and the consequent changes wrought in the ovaries and uterus have been described. We have now to trace the correlated changes wrought in distant organs and in the constitution at large.

Impregnation—that is, fertilization—of the ovum is no sooner effected than the new impulse dominates the entire system. The embryo grafted on the mucous membrane of the uterus sits like a despot on his throne. The uterus and placenta are built up for its accommodation and growth. Its imperious demands tax every tissue and every organ in the body. Generally, it is true, a fair equilibrium between the wants of the parent and those of the embryo is maintained. The embryo is supplied without injury to the parent. But sometimes the demands of the embryo are so exacting that the parent cannot keep pace with them. She may perish from exhaustion, the embryo perishing with her, but not seldom surviving her destruction.

The physiological phenomena evoked by pregnancy must be studied and grasped as a whole—that is, as forces called into combined action to accomplish a definite object. We cannot arrive at a just idea of the state of any one organ or system of organs without taking into consideration the state of all the rest in their absolute and relative conditions.

A general law has been formulated by Robert Barnes, viz.: *Since, in pregnancy, every organ and the whole organism are specially weighted, undergoing extraordinary developmental and functional activity, so any defect or fault inherited or acquired, howsoever latent, will be liable to be evolved or intensified under the trial. Hence, pregnancy is the great test of bodily soundness.*

When in a sound body, the just balance is kept between the several functions, and in the relations of parent and embryo, we may expect the course of pregnancy to run smoothly. When, on the other hand, one organ or system of organs is damaged or overtaxed the balance is disturbed, and we may expect various morbid manifestations. The so-called diseases of pregnancy spring directly out of exaggerations or defects of the normal pro-

cesses. They bear the seal of the gestation process. They form a group governed by one common law.

The pathology of gestation then is simply a chapter in extension of the physiology of that process. It is especially in the study of normal and disordered gestation that we see demonstrations of the universal law, which may be formulated as follows: *Pathology is physiology working under difficulties.*

In describing a complex condition some system must be followed. We may begin with *the nervous system, which probably first feels the influence of pregnancy.* The alterations observed are: 1, increased psychical mobility; 2, increased emotional mobility; 3, increased diastaltic or reflex mobility; 4, increased ganglionic activity. These are manifested in various ways, partly subjective, partly objective.

The psychical and emotional alterations we cannot now dwell upon at length. Throughout the animal world the influence of gestation upon the female organism may be traced. And so striking is the influence of this process in many plants that we are almost tempted to deduce from it an argument for the existence in them of a nervous system. We cannot deny them the possession of a force of equivalent value. The wonderful changes undergone by the plant during inflorescence, fertilization, and fructification present many points of analogy with the corresponding processes in animals. Who can see without wonder the upspringing of the stamens to join the pistil in the berbery at the slightest touch? It is strangely suggestive of the reflex function in animals.

In all ages, poets, by the divine afflatus gifted beyond other men with true insight into the energies of the animated world, have been struck with the transforming force of gestation. Thus Browning, greatest of all poets in mental analysis, describes

> The strange and passionate precipitance
> Of maiden into motherhood,
> Which changes body and soul by Nature's law;
> So when the she-dove breeds, strange yearnings come
> For the unknown shelter by undreamed-of shores;
> And there is born a blood-pulse in her heart
> To fight if needs be, though with flap of wing,
> For the wool-flock or the fur-tuft, though a hawk
> Contest the prize.

Here the physician, the poet, the historian, the moralist, the jurist meet upon common ground.

The general character of the alterations in the nervous centres may be summed up as exalted tension. Like a highly charged battery, they respond more energetically to slighter provocation. We may pass by the manifestations of exalted psychical and emotional tension. The most striking and perhaps the most pertinent to our theme are the evidences of exalted and diastaltic tension. This tension increases with the advance of pregnancy, reaching its climax when labor is due.

One of the earliest manifestations is seen in *the morning sickness.* This does the duty of a regulator or governor of nervous energy, not only letting off excess of energy that may have accumulated in its diastaltic centres, but reducing the tension of all the nervous centres. The woman is sensible of quick relief. Many women suffer from spasmodic twitches of the legs quite uncontrollable. In all women, the increased development of structure and activity of function taking place in the glandular system especially, and in the enormous work of nutrition going on in the uterus, consume a vast amount of nerve energy. To keep up the supply, a little excess, a reserve

is necessary. Under certain conditions this excess may not be readily controlled or used up in a healthy manner. Then it is apt to run in abnormal courses to waste, or to work mischief. The morning vomiting, and other apparent nervous aberrations, are conservative in their action, preventing serious disorders, taking off intolerable strain, perhaps averting convulsion, frequently averting abortion by diverting nervous energy from the uterus.

How is this great amount of nervous energy produced? Does it not mply a corresponding increase of nerve-tissue, greater development of the substance of the nervous centres? This hypothesis is supported by many facts. If a leg is amputated, the part of the spinal cord which supplied it with nervous energy shrinks. Every structure called into unwonted functional activity undergoes a physiological hypertrophy. The heart does this in pregnancy. It is, therefore, reasonable to suppose that the spinal cord does so too. That there is a remarkable development of new nerve-tissue in and about the uterus is now recognized as an anatomical fact. Physiologically this increase is an *à priori* necessity. The scales and the microscope will one day put this hypothesis to the test.

Changes in the blood necessarily attend the increased demands of nutrition to maintain and develop the organism.

The Blood-mass is Notably Increased.—This is especially observed in the second half of pregnancy. The newly developed uterine sinuses contain a large quantity; and the arteries, veins, and capillaries generally are more distended, and there is in addition a development of new vessels or enlargement of old vessels in immediate relation with the pelvic viscera especially, but real also in relation with the abdominal viscera and glandular system.

The Constitution of the Blood is Altered.—The original observations of Andral and Gavarret have been confirmed by Becquerel and Rodier, Regnault, and more lately by Nasse.[1]

These modifications consist in *increase of water*. In the non-gravida the proportion is 791 in 1000, and in the gravid, according to Regnault, 817 in 1000 in the two latter months; but it is marked much earlier.

The *red globules diminish* from the onset of gestation. The diminution is slight in the first five or six months, sometimes considerable towards the end of gestation. According to Andral and Gavarret, the proportion of globules in the non-gravida is 127 in 1000; at the end of gestation it is only 104.9 in 1000.

In some cases there is *increase of white globules*, a kind of normal leucocythemia. Becquerel and Rodier found the proportion of *albumen* in non-gravidæ 70.5 in 1000; in the gravidæ, 66.1 in 1000. Regnault gives similar results. Virchow describes this as a *physiological leucocytosis*.

Fibrin diminishes until about the sixth month. From that time *it rises*. Andral and Gavarret give the mean in non-gravidæ as 3 in 1000, during the first six months of pregnancy as 2.5 in 1000; and in the last three months as 4 or more—that is, above the physiological standard. It resembles the blood in inflammation. It "cups" when drawn into a basin. Jacquemier affirmed that when the blood cupped there was fever. Robert Barnes is able to state that the blood of gravid women may "cup" when there is no fever. Increase of fibrin remains some time after delivery. It is important to remember this in studying puerperal diseases, lest we take excess of fibrin as evidence of fever or inflammation.

Becquerel and Rodier say the *iron diminishes*.

The ordinary proportion is	0.541 in 1000.
In pregnancy the proportion is	0.449 in 1000.

[1] Archiv für Gynäkologie, 1876.

The general result is that we have in gravid women blood in greater volume, more watery, diluted, deficient in the more vital qualities, overcharged with excrementitious matters. Beau describes the condition as hydræmia, Andral attributes more importance to the diminution of globules. Cazeaux likens it to chlorosis. It is a relative anæmia. Andral and Gavarret found the globules returns after gestation.

Changes in the Circulating Organs.—Increased nervous energy, increased volume of blood, increased work of nutrition throw increased work upon the heart and vascular system generally. The fulness of the vessels taxes the heart to greater exertion. The momentum is increased, the heart beats more frequently. Larcher in 1857 made known from researches carried out in the Paris Maternity in 1826, 1827, on 130 women dying in pregnancy or shortly after labor, that the left ventricle of the heart became hypertrophied; its walls thickened by at least a fourth. The right ventricle and auricles were not affected. Ducrest, applying the test of measurement to 100 women, confirmed Larcher. Blot, applying the test of weight, found this increased by one-fifth, and that this increase is limited to the left ventricle. He further established that this hypertrophy of the heart being normal, called into existence for a special and temporary duty, is resolved after labor like the hypertrophy of the uterus.

Joulin (1866) concluded that the hypertrophy of the heart coincides with increase of volume of the uterus, and that the return of the two organs to the ordinary physiological dimensions takes place simultaneously.

It is necessary to state that Löhlein, citing Friedrich, Virchow, Dusch, disputes the conclusions of the French authors. Robert Barnes, having had opportunity of witnessing some of the observations made in Paris, and of making others in England, not without diffidence, when names so eminent stand in conflict, feels justified in affirming that he has almost invariably found the weight of the heart of women dying soon after labor to be an ounce or more in excess of the standard of eight or nine ounces.

De Cristoforis, of Milan, has made instructive observations on the effect of pressure in the gravida.[1]

The mechanical action of pregnancy causes hydraulic derangements in the circulation. He describes a *mechanical inferior venous hyperæmia*, the result of the pressure of the gravid uterus on the iliac veins; and a *superior arterial hyperæmia*, the result of the pressure upon the abdominal aorta at the bifurcation of the iliac arteries. This gives rise to an imperfect distribution of blood, in *minus* to the lower extremities, in *plus* to the upper parts. The passage of the blood downwards is impeded. A primary effect of this is hypertrophy of the heart, stimulated to stronger efforts to overcome the mechanical obstacle. He thinks this has more influence than the simple physiological nisus, which Larcher thought was the main cause. Other applications of this theory will be discussed under the description of the "Diseases of Gestation."

The pressure-theory has been overstrained by others as well as by De Cristoforis; but it is certain that it exerts some influence upon the circulation. The sphygmograph, however, has given greater precision to our knowledge of this subject. It proves that high tension begins early in pregnancy, long before the uterus is large enough to cause any appreciable pressure upon the aorta or iliac arteries.

The observations of Marey, Mahomed, Macdonald, Fancourt Barnes, and others, illustrate the history of high tension with sufficient completeness to prove that the hypertrophy of the heart and other conditions long attributed to pressure upon the vessels are accounted for in a different way.

[1] Annali Universali di Medicina, 1867.

In many women the normal sounds of the heart are changed. Jacquemier found a *bruit de souffle in the last three months*, feeble and variable, and disappearing after labor.

The heart beats more quickly in the gravida as well as more forcibly. The pulse is harder. That is, the arterial tension is greater. Hémey[1] takes 75 as the average pulse of a healthy woman. Before labor it is from 75 to 84. Blot and others have verified the fall of the pulse after labor.

The peripheral capillary vessels in every part of the body are fuller and more developed. The veins, deep and superficial, are more developed, especially in the great centres of developmental nisus, the pelvis and breasts. Veins scarcely visible before become prominent, on the legs sometimes forming varices, at the anus forming hemorrhoids; in the vagina bulging, turgid, forming sometimes prominent masses, and giving the deep purple color to the mucous membrane characteristic of gestation. Nævi materni become more vascular.

The lymphatic vessels and glands undergo enormous development. The important part taken by the lymphatics in nutrition is an indication of their importance in puerpery and in their relation to septicæmia.

The respiratory apparatus undergoes changes mainly through *mechanical pressure.* The growing uterus alters the form and capacity of the chest. Küchenmeister (1849), and Fabius afterwards, by spirometric observations found that the base of the thorax increases in width during the latter months. Their results are confirmed by Wintrich and Dohrn.[2] Dohrn found in most cases that the base of the thorax during gestation presents greater width, but a diminished antero-posterior diameter. After evacuation of the uterus this relation is reversed; the transverse diameter lessens, the antero-posterior increases. The circumference remains the same. The diaphragm is pushed up, so that the vertical diameter of the thorax, and therefore its total capacity, are lessened. Hence in the latter months of gestation, the respiratory movements become more frequent, less full. Dyspnœa is easily excited by exertion. This dyspnœa is exaggerated in cases of rickets, osteomalacia, or deviations of the spinal column, and in some cases of extreme enlargement of the uterus, as from twins or excess of liquor amnii; conditions which compel the uterus to encroach further on the thoracic cavity.

Respiration is relieved during a few days preceding labor, when the head descends into the pelvis.

Certain *chemical changes* are produced in the process of respiration. Andral and Gavarret proved that the exhalation of carbonic acid by the lungs was increased during gestation as it is at the menopause.

The Liver Presents Important Alterations.—Tarnier, in 1857, thus sums up his observations: The liver is increased in volume; the liver-tissue does not present a uniform color; its substance is interspersed with small yellow spots, very numerous, which give it a granitic aspect. These spots seem to form so many jutting points, in size varying from that of a pin's head to that of a millet-seed. These spots are sometimes scattered; at other times gathered together, forming islets; lastly, in some points the agglomeration is such that there results a large "plaque" or patch several centimetres in diameter. This aspect is not confined to the surface; it is also seen in sections in the thickness of the organ. There are found in this tissue hepatic cells well preserved, in the midst of which are very numerous droplets of fat.

Tarnier associates this condition with the glycosuria of pregnant women. De Sinéty thinks it is only developed with lactation; that it progresses with

[1] Archives générales de Médecine.
[2] Monatsschr. f. Geburt

lactation, and finishes with it. Certainly lactation and glycosuria are intimately related.

De Sinéty always found the fat abundant in the centre of the lobule of the liver, whilst it was absent or very rare in the periphery. This disposition is the reverse of what is observed in the fatty degenerations or infiltrations due to a pathological cause or to artificial fattening.

Robert Barnes's observations agree with Tarnier's, that this fatty change takes place in pregnancy. Dr. Ewart, at St. George's Hospital, has verified this change in several instances. Further observations to illustrate the condition of the liver in women who do not suckle would be interesting.

Glycose.—In 1856 Blot announced *physiological glycosuria*. He found it in nearly half the pregnant women examined. He said it continued during lactation. Kirsten[1] calls this frequency in doubt. Robert Barnes has observed it in a very marked degree in women when pregnant who showed no sign of illness, and who lost it after delivery and lactation. Dickinson has seen many cases of diabetes insipidus in gestation.

The urinary apparatus and its functions are always to some extent, often to a serious extent, affected. It is convenient to begin with the bladder, urethra, and meatus urinarius. From the fourth month the bladder is drawn up nearly above the brim of the pelvis, pushed forwards by the uterus. In this action the peritoneum is partly dragged off the bladder. During labor the stripping is still more marked. Thus there is often accumulation of urine in the hypogastric region. The urethra is dragged up, and the meatus is often hidden behind the pubes. These conditions are especially marked in the case of retroversion of the gravid womb. The surrounding tissues are often œdematous. In the early stages of gestation, frequent micturition is observed in many cases, due to the pressure of the enlarging fundus uteri upon the bladder. This trouble is often felt towards the end of gestation. Rarely retention of urine occurs from dragging of the urethra.

The Kidney.—The close relations in function between the liver and kidney imply that the kidney will present changes not less important than its associated organ. Hyperæmia, even congestion, are frequent; increased epithelial formation, a minor degree of fatty change, are not uncommon. This is often attributed to pressure upon the renal vessels by the gravid uterus. The influence of this cause appears to us to be much exaggerated. The kidneys are so placed in the groove on either side of the lumbar vertebræ, that direct pressure upon them can hardly take place; they and their vessels are further protected by lying above the angle of divergence of the growing uterus from the spinal column; and pressure is further lessened by the intervening intestinal canal, whose convolutions, filled with air, act as a buffer or pad between the firm gravid uterus and the spinal column. The backward pressure of the uterus is never constant; it is always mitigated by its own elasticity, plasticity, and by the yielding of the abdominal walls.

The Urine is Altered.—Chalvet and Barlemont (1870) studied this subject. The urine is mostly acid, sometimes neutral, rarely alkaline. The water is increased in proportion. At the commencement the solids are rather less. Chlorides, however, increase. Phosphates, sulphates, urea, uric acid, creatine, and creatinine diminish. The diminution of phosphates, sulphates, and urea is especially remarkable; it had been noticed by Lehmann and Donné. These observers suggest that the elements in defect in the urine are used in constructing the child. Chalvet and Barlemont attribute increase of chlorides to disassimilation of the mother's tissues.

[1] Monatsschr. für Geburtsk., 1857.

KYESTEIN.—Nauche (1831) first described this as peculiar to pregnancy. If freshly collected urine is put into a glass in a well-lighted and aired spot, the following things are observed: After three hours there appears on the surface an iridescent pellicle (the kyestein), at first thin but gradually thickening. Towards the fifth day this pellicle breaks up, from centre to circumference, into pieces which sink to the bottom, where they form a deposit. Other pellicles may succeed the kyestein. The pellicle is not formed by a special organic substance peculiar to pregnancy. It has been observed under many other circumstances. It consists of crystals of ammoniaco-magnesian phosphates, vibriones, and monads.

Lehmann says the urine of women contains more water, less salts, and less urea than that of men. These differences are especially marked in pregnancy. As watery urine becomes more easily alkaline than concentrated urine, the urine of women more easily undergoes this reaction. It owes to the mucus which it contains the property of effervescing at times and of being covered with a pellicle (of *kyestein*), consisting of ammoniaco-magnesian phosphate and cryptogamia, and which was formerly regarded as exclusively belonging to the urine of pregnant women. These results are confirmed by Parkes, who reminds us that kyestein was at one time supposed to be composed of casein, derived from the mammary gland. He adds, very similar appearances are found less frequently in the anæmic urine of non-gravid women, and sometimes in the urine of men.

Elisha K. Kane describes the characters of kyestein in like manner. The cheesy odor he found in only a small proportion of cases. He does not regard it as an unerring sign of gestation.

Braxton Hicks ("Guy's Reports") has investigated the subject with great care. His conclusions agree with those above cited. He has found kyestein in virgins.

We may in conclusion state that, assenting to the propositions of these authorities, we have seen several instances in which a confident diagnosis of pregnancy expressed on the evidence of this appearance proved to be correct. Whilst, therefore, it is unsafe to affirm gestation on this ground alone, it may be enough to direct the physician to search for further evidence in affirmation or negation.

PHYSIOLOGICAL ALBUMINURIA.—Lever (1843) and Sir James Simpson, a little later, signalized the association of convulsion in pregnant women with the presence of albumen in the urine. The occurrence of albumen in the urine seems to mark the borderland between physiology and pathology. When things go smoothly, the urine is not tested, and the possible presence of abnormal ingredients escapes recognition. When convulsions set in during gestation, the urine is straightway examined; and albumen in considerable quantity is almost constantly found. This almost constant association is so deeply impressed upon the medical mind that we are apt to stretch it to the absolute conclusion that as convulsion implies albuminuria, so albuminuria implies convulsion. Logically this does not follow; and clinically it is not true. The systematic examination of the urine of a number of cases has revealed the fact that in a certain proportion of women albumen was found in more or less notable quantity, who notwithstanding went through gestation and labor without accident. We must then admit that the presence of albumen in the urine may be simply the indication of a physiological difficulty; and that the escape of albumen by the kidney may be a natural means of relieving vascular tension. The important researches of Dr. Mahomed point to the conclusion that the appearance of albumen in the urine is the direct consequence of high arterial tensio[illegible] "pre-albuminuric stage," the premonitory indicat[illegible]

which if continued or exalted is followed by albumiuuria. Albuminuria is frequently due to blood-exudation from the bladder. This is here distinctly proved.

The great lesson to be borne in mind is that the appearance of unusual ingredients in the urine—as glucose or sugar, albumen or leucine—is the signal of transition from physiological to pathological processes, and should warn us to institute a thorough examination of all the organs and functions with a view to clinical action.

The glandular system undergoes remarkable development. The changes in the liver, kidney, and cutaneous glands have been noticed. The glands of the alimentary canal will be referred to in another part when treating of salivation and vomiting. We may here specially mention the thyroid. This is generally larger in females than in males. J. F. Meekel, by a figure of speech, regards the thyroid as the repetition of the uterus in the neck, referring to the swelling which the thyroid presents during menstruation and pregnancy. It is a familiar classical story that the effect of pregnancy, or in some cases of marriage, was noticed by the ancients. Thus Catullus in the "Epithalamium":

> Non illam nutrix oriente revisens
> Hesterno poterit collum circumdare filo.

The enlargement of the thyroid is now known to be dependent upon increased action of the heart.

The breasts anatomically belong to the system of skin-glands. But their more immediate relation to the work of reproduction makes them a special focus of activity. The changes wrought in them are specially described under the "Signs and Diagnosis of Gestation."

The spleen exhibits similar conditions to those observed in the liver and kidney. It enlarges notably; sometimes remains permanently hypertrophied.

The digestive apparatus is affected mechanically and functionally. The rectum is compressed. Constipation is promoted; and this is not explained simply by pressure. The peristaltic action of the bowels is interfered with.

The small intestines are pushed backwards and upwards by the growing uterus, which keeps in front close to the abdominal wall. They undergo considerable compression, and in their turn press upon the stomach.

The mucous membranes and the intestinal glands become more vascular. The glands of the stomach especially are more developed, and are thus enabled to throw off large quantities of water, of which the vomiting of early pregnancy largely consists. This is a physiological act, one of the provisions for relieving high vascular and nervous tension.

A very common thing in pregnancy is increase of appetite. Absolute hunger, a sensation perhaps rare when not pregnant, is felt by some women even though they do not suffer from vomiting. They have to eat for two.

The appetite is often capricious. Things previously relished become distasteful. The "longings" of pregnant women are notorious. There is no doubt an instinctive craving for certain things for which a physiological call might be found. Sometimes the "longings" are of an insane character, as in the case of the woman who, craving her husband's flesh, killed him, and to prolong her enjoyment salted him down.

The skin, a tissue lying conspicuously open to objective study, presents several important changes. Under the distention of the abdomen the skin, overstretched, cracks and presents the appearance of scars. Often the abdominal skin not yielding fast enough, call is made upon the skin of the upper and outer part of the thighs, where similar cracks also occur. The

significance of this change will be more particularly discussed under the "Diagnosis of Past Pregnancy."

A remarkable phenomenon is *pigmentation*. In this singular process the peculiar state and action of the nervous and circulating systems and the blood are most remarkably manifested. Concerning this little precise knowledge has been gained. It lies open as a fertile field of study. A thorough investigation of the conditions under which pigmentation is produced in pregnancy could not fail to repay the trouble, and would probably lead to the solution of other physiological and pathological problems. Some illustrations are collected in Robert Barnes's memoir.[1] The *melasma* of the face, abdomen, and breasts during pregnancy is the most familiar. It occurs also in some cases of ovarian disease. Sometimes in cases of functional disorder of the reproductive organs. Under normal and difficult menstruation it is observed. Le Cat refers to a case in which the left leg became black during each pregnancy. The mammæ of the Samoyed women are black. Dr. Latham, who notices this, thinks it may be due to a peculiar mode of sexual excitation. Amongst the several forms the most common is discoloration of the eyelids. There are two varieties; one in which there is simply a pigmentary deposit in the epidermic scales, like the ordinary swarthiness; and another, in which there is a deposit of free pigment on the skin, so that it can be wiped off. This latter is the true *Stearrhœa nigricans*.

Discoloration of the eyelids during menstruation is not necessarily due to pigment. In some cases it is due to a sort of venous lividity. This lividity differs, however, so much that there is probably pigment in the blood, but not deposited in the epidermic cells. Permanent or chronic blepharal melasma is seen in women with chlorosis or melancholia. In some cases, brown specks on the forehead, eyebrows, nose, and upper lip, produce a characteristic effect described as the "Mask of Gestation." An example of blue discoloration, *Stearrhœa cerulea*, is recorded in a pregnant woman by Büchner.

Laycock says this production of pigments may be looked upon from three points of view: (1) as the result of imperfect oxidation of carbon, so that it is not eliminated as carbonic acid, lactic acid, hæmaphein, etc.; (2) as the result of imperfect elimination of carbon proper, where that is the normal excretion, as in the hair and epidermic scales; (3) as the result of excess in the production of carbon from highly carbonaceous foods. In all there is a close analogy between the carbonaceous excreta as morbid pigments and the nitrogenous excreta as morbid pigments, and the nitrogenous excreta as morbid deposits of urates, etc. As to the first, it is obvious that all modifications in the blood-corpuscles which impair their functions as oxygen-carriers will favor imperfect oxidation of the carbon waste. Thus we can understand how carbon may be substituted for carbonic acid and lactic acid in leukæmia, leucocytosis, the anæmia of chlorosis, Bright's disease, and all cachectic states in which the blood-corpuscles are defective in oxygenating power. These are conditions closely represented in pregnancy.

In many cases, if not in all, the nervous system is closely concerned. Lister says, "the cerebro-spinal axis is chiefly concerned in regulating the function of the pigment-cells." It is extremely interesting to note that the pigmentation is often limited to areas more or less sharply defined. A singular example is figured in the "Obstetrical Transactions," 1875, by Dr. Godson. A girl, seven months pregnant, had chorea. She exhibited a characteristic dark pigmentation of the areolæ of both breasts, leaving an area of about one-third perfectly clear. This free area was almost exactly

[1] "On Pregnancy and General Pathology," Amer. Gynec. Trans., vol. i.

symmetrical, and sharply limited. It is inconceivable that any difference in the quality of the blood going to the part could exist. We can but conclude that this partial pigmentation was determined by nerve-distribution.

The discovery of Addison and the experiments of Brown-Séquard go to show that the suprarenal capsules play an important part in pigmentation.

Wilks observed[1] that in Addison's disease the pigmentation was more marked at the nipples, the navel, and the scrotum. These and other cognate facts lead us to conjecture that in pregnancy the suprarenal capsules, like other organs and tissues, undergo a special modification; that this modification also is transitory, and in harmony with the changes observed in other organs. It is curious to remark how rapidly and completely sometimes the dark pigmentation arising during pregnancy disappears after delivery.

It is certainly desirable that the suprarenal capsules should be examined in women dying during gestation and childbed.

Nævi become more vascular, turgid, and deeper colored. This is due to the general increase of development of the capillaries. It is closely associated with the process of pigmentation. The *sebaceous* and *sudoriparous glands, and hair-follicles* often exhibit increased activity. The fuller peripheral circulation and greater vascular tension may account for this. We have observed that some women who had been losing hair when not pregnant found its growth restored during gestation, and fall off again after labor.

The osseous system undergoes changes which, if not always evident, are rarely absent altogether. Under the combined influences of changes in the constitution of the blood, in the dynamics of the circulation, and in nutrition, softening of the pelvic joints takes place.

This subject is more fully discussed in the description of the "Structure and Behavior of the Pelvis."

The incurvation of the spine is increased. To maintain the equilibrium in the erect posture the woman throws the shoulders back, and so the anterior curve is increased.

Osteophytes.—Rokitansky in 1838, Ducrest in 1844, at the Paris Maternité, observed *osseous neoplasms or osteophytes*, or a tissue resembling bone, outside the dura mater, between it and the inner table of the cranium. They both believe these formations to be independent of pathological causes. They found them in more than one-third of the cases. Alexis Moreau, in 1844, examined ninety-eight women dying in childbed at the Maternité; forty-two presented osseous concretions. He did not find them elsewhere than in the cranium. On the other hand, Virchow found similar concretions in phthisical subjects. Kühn analyzed them and found them richer in lime and carbonic acid, poorer in phosphates and animal matter than the cranial bones. These concretions suggest the hypothesis that they are a part of the excess of ossific material prepared for the building up of the fœtal skeleton. Robert Barnes called attention to their relation to the calcareous degeneration of the placenta. They have also probably some relation to the preparation of milk, in which fluid a considerable proportion of calcareous elements exists.

Wallmann ("Virchow's Arch.," 1858) has frequently observed osteophytes on the inner surface of the cranium in subjects from ten to seventy-five years of age in different forms of disease. He confirms Virchow's statement that they are not less common after other diseases than in gestation. He says, nevertheless, that he almost invariably found them in puerperæ. The next most frequent relations are tuberculosis, chronic hydrocephalus, secondary syphilis.

[1] Guy's Hospital Reports, 1859.

The body-weight undergoes remarkable changes. These have been studied by Gassner.[1]

The results are so interesting that they deserve full analysis; and although many of the applications will more properly be discussed in the history of the diseases of pregnancy and childbed, it will be useful to give here a connected summary of them.

1. The pregnant woman gained in weight during the last two months, 1.5 to 2 kilogrammes.

2. She lost weight 2 to 3 kilogrammes within eight to fourteen days after the death of the embryo. In one instance, death of the fœtus was diagnosed through the loss of weight. Whence this increase? What are the factors of the increase?

	Kilog.	Of liq. amnii.
We estimate the increase of child in 8th month . .	0.50	0.375
" " " 9th " . .	0.75	0.25
" " " 10th " . .	0.75	0.25

The placenta gains in the three latter months about 0.084 kilogramme. Thus the ovum gains about 1 kilogramme in each of these three months.

THE MEAN WEIGHT OF THE PREGNANT WOMAN.

At the end of tenth month.		At end of normal labor.		Of puerpera of seven or eight days.	
Cases.	Kilo.	Cases.	Kilog.	Cases.	Kilog.
242	62.8	190	56.25	269	51.45

The loss of weight from normal labor is 10.45 per cent. The ovum is the chief factor in this loss. Its average weight is 5.76 kilogrammes, consisting of

Child	3.283 kilog.
Liquor amnii	1.877 "
Placenta	0.600 "

There is a further loss of blood, 0.25 kilogramme; of excrement, 0.404 kilogramme; of transpiration by lungs and skin, 0.15 kilogramme.

He further arrived at the following general facts: the larger the child, the larger the placenta and the more the liquor amnii.

The child of a primipara weighs on an average 0.104 kilogramme less than the child of a pluripara, and in accordance the liquor amnii and the placenta of a primipara weigh less than in the pluripara.

The uterus of a primipara is poorer in muscle. He connects this relative poverty of muscle with the duration of labor. The mean duration of labor in 110 pluriparæ was 10.40 hours; in 110 primiparæ, 15.52 hours.

He found a constant increase of liquor amnii with cross-births.

Loss of Weight after Normal Labor.

From secretions and excretions and diminished diet a woman of average weight of 56.25 kilos. loses in 172.43 hours (238 cases) 4.575 kilos.; so that the loss is as 1 : 12.305, or about 8 per cent. The factors are—lochia and milk, increased urine from resorption of œdema of legs, lung and skin exhalations, feces, involution of outer and inner genitals.

In connection with the body-weight we may study that phase of nutrition which relates to *fat*. It is a general rule that pregnant women lose fat, Waste of this element is more especially seen in the face: the features grow thinner and sharper. This is more marked in women who suffer much from vomiting. The deficiency of ordinary food is to some extent compensated by

[1] "Ueber die Veränderungen des Körpergewichtes bei Schwangeren, Gebärend und Wöchnerinnen." Monatsschr. f. Geburtskunde, 1862.

the absorption of fat. If a healthy woman, in whom menstruation is suspended, is seen to grow thin, it may be presumed that she is pregnant. On the other hand, many fat women show but little difference in adiposity during pregnancy. When married women quickly grow fat the probability is that they will remain sterile. Kiwisch[1] has never observed a general increase of fat in pregnancy. He says the waste of fat is observed in the floor of the perineum, the abdominal walls, and thighs. We, however, know some women who improve generally in nutrition and fat when pregnant.

The changes wrought in the body generally and the non-sexual organs having been described, those which affect the genital apparatus have now to be traced.

Modifications of the Uterus.—The uterus undergoes changes of volume, capacity, weight, form, situation, direction, relations.

INCREASE OF VOLUME.—The neck of the uterus is not remarkably changed until the later months of gestation. This change will be described hereafter. The mucous membrane and the cervical glands partake of the general increase of vascularity. Lott says it undergoes true hypertrophy. The glands are enlarged and secrete more actively. They throw out the viscid albumen-looking mucus which fills the cervix, known as the mucous plug. The bulk of the cervix is somewhat increased—it becomes thicker. It may be here noted that the mucous membrane of the neck, unlike that of the body, does not fall at the time of labor. It is not deciduous. After the expulsion of the mucous membrane of the body of the uterus there remains at the point of separation a more or less prominent ring.

The body of the uterus undergoes the most marvellous transformation. Levret measured the virgin uterus and found its surface presented 16 square inches, whilst the uterus at term gives 339 square inches, that is, it is multiplied twenty-one times. This increase of volume depends upon two causes acting together—passive distention and hypertrophy of its walls. The distention is in proportion to the development of the ovum, and takes the chief part in the increase of volume. Thus, as soon as the ovum is expelled the uterus retracts, and loses the greater part of the increase of volume acquired during gestation.

True hypertrophy also takes place, since the uterus, retracted as described, weighs considerably more than in the non-gravid state. In order to regain the condition of the non-gravid state a further process of absorption of the excess of tissue, known as *involution*, must be carried out. Hypertrophy takes place under the influence of gestation alone, as when the gestation has its seat outside the uterus, or in one horn of a two-horned uterus. The empty uterus also grows.

The uterus grows with the advance of gestation. Arthur Farre gives the following table:

TABLE SHOWING RATE OF INCREASE IN SIZE OF UTERUS ACCORDING TO MONTHS OF GRAVIDITY.

	Length.		Breadth.	
	Inches	Millim.	Inches.	Millim.
End of 3 months	4½–5	113–126	4	101
" 4 "	5½–6	138–151	5	126
" 5 "	6–7	151–176	5½	139
" 6 "	8–9	201–226	6½	164
" 7 "	10	252	7½	189
" 8 "	11	277	8	202
" 9 "	12	302	9	227

[1] Beiträge, 1848.

CAPACITY.—Simpson estimated the capacity of the uterus of the multipara before impregnation at 2 to 3 cubic cm., and at 6 to 8 cubic litres at term; but Tarnier says this is exaggerated, the mean being 4 or 5 litres. The dilatation varies with the size of the child, and in the case of twins, and excess of liquor amnii.

WEIGHT.—At term the uterus and ovum weigh from 6 to 7 kilos; before impregnation the weight in nulliparæ is 42 grammes, and 55 in multiparæ. After labor and expulsion of the placenta, the weight of the uterus with its appendages is, according to Naegelé, from 750 to 1000 grammes. Tarnier places it higher—that is, at from 900 to 1200 or 1500. It thus becomes twenty times heavier under gestation. Thus, the increase of weight is in direct ratio with the increase in volume.

FORM.—Different parts of the uterus are developed successively. At first, the anterior and posterior surfaces lying in contact before conception, part. The cavity, at first potential rather than actual, is triangular. The uterus then becomes pyriform, but always remains somewhat flattened antero-posteriorly. At the third month it is spheroidal.[1] Then the fundus becomes more arched, and is the principal seat of development, the lower third or segment remaining but little changed.

In the latter three months the lower segment is developed. Sometimes one side of the fundus is more developed than the other, presenting a perceptible outbulging to palpation. This may be due to the more prominent side lodging the larger part of the fœtus, so that there may be felt a depression or groove between the two angles of the uterus. When twins exist a groove may also be observed at the fundus.

At the end of gestation the inferior segment plunges into the pelvic cavity, whilst the upper two-thirds or three-fourths rises into the abdomen. At this time the uterine walls are plastic enough to mould themselves on the sacrum and vertebral column, thus forming at the level of the promontory a marked retreating angle. Sometimes, as in pluriparæ whose abdominal walls offer little resistance, the fundus falls forwards over the symphysis, and then the uterus forms a retreating angle or curve on the anterior surface.

Depaul further draws attention to the irregular development of the two sides of the uterus. It is rare to find the two tubes at the same level.

Usually the posterior wall grows in its upper two-thirds more than the anterior wall. Thus it will be seen that the insertion of the tubes is no longer situated at the union of the anterior and posterior halves of the uterus, but much more forward—that is, two-thirds of the uterus will be behind the seat of insertion. The contrary takes place in the inferior segment, which is more developed before than behind. This circumstance explains why the neck appears so strongly deviated backwards, making it difficult to reach at the end of gestation, and why the head engaging in the cavity is usually capped by the anterior wall of the lower segment (the anterior uterine valve of Robert Barnes).

SITUATION.—The changes of situation are worthy of note. They will be traced in the description of the diagnosis of gestation. We may here observe that in the latter months the uterus, especially in pluriparæ with lax abdominal walls, is different in the dorsal decubitus and in the upright posture. In the first posture the fundus falls back nearer to the spinal column, so that the whole organ forms a curve around the sacral promontory; whereas, in the upright posture, the fundus, falling forwards, quits the spine, bulges out the belly, and its axis straightens.

The projecting spinal column naturally throws the body of the uterus to

[1] See Bandl's figure, further on.

one or other side, so that there is lateral obliquity. Dubois found that of 100 women the uterus was in the median line in 20, and inclining to the left in 4, to the right in 66. Many explanations of the more frequent right obliquity have been given. None appear to be conclusive.

Rotation.—The uterus commonly is turned a little on its axis, so that the anterior face looks to the right and the posterior face looks to the left and backwards. Tarnier points out that it is due to the left lateral border being thus brought more forward that the uterine souffle is more frequently heard on the left side. In opening the abdomen in Cæsarean section, this rotation has to be corrected in order to bring the median line of the uterus into relation with the abdominal incision.

Relations.—At term the anterior surface of the uterus rests by its upper three-fourths against the abdominal wall; sometimes a bit of omentum or intestine slips down between. This must be guarded against when practising Cæsarean section. In its lower fourth the anterior surface of the uterus is applied to the posterior surface of the bladder to an extent varying with the size of the bladder. When empty the bladder falls behind the symphysis; when full, it rises in front of the uterus, forming a large fluctuating tumor. Quite below, the anterior aspect of the uterus is in relation with the vagina.

The posterior aspect is in relation below with the rectum, sacrum, sacro-vertebral angle, and less closely with the common iliac vessels and the first branches of the sacral nerves; above, with the vertebral column, aorta, vena cava inferior, the pillars of the diaphragm, the mesentery, and the lower part of the ilium. Often some intestinal fold gets between the vertebral column and the upper half of the uterus.

The upper border or fundus answers to the transverse colon, the greater curve of the stomach, the anterior edge of the liver, and it even lifts up the xiphoid cartilage and the lower false ribs, pushing them outwards.

The lateral borders are in relation, below, with the internal and external iliac vessels, the obturator nerves, and the psoas-iliac muscles. Above, the right lateral border is in relation with the cæcum and ascending colon; the left lateral border with the sigmoid flexure, the descending colon, and a great part of the small intestine, which runs to the upper left side of the abdomen in consequence of the usual inclination of the uterus to the right. The lower extremity of the uterus projects into the vagina, and is applied in front to the bladder, behind to the rectum.

Thickness of the Uterine Walls.—The uterus enlarging partly by distention, yielding to the growth of the fœtus, is *thinned*—that is, the thickness of the wall of the uterus at term is generally somewhat less than that of the non-gravid uterus. Hence the parts of the fœtus are often felt with great distinctness on palpation. Sometimes it is barely 9 mm. thick at the part to which the placenta adheres, and only 2 mm. in other parts. The thinning is not uniform; thus, at the fundus and posterior wall, Smellie and Hunter noted special thinning. The thinning, however, varies in individuals; we believe it is less marked in multiparæ.

Consistency.—When empty, the uterine walls are firm, resisting like fibrous tissue. During gestation this firmness diminishes; the walls become soft and elastic, giving to the fingers a sensation resembling that felt on pressing upon a band of India rubber. This suppleness explains how it is that the walls can mould themselves upon the fœtal parts, the spontaneous movements of which produce bumps, which sink again before the eye.

The *changes undergone by the mucous membrane of the uterus* have been described in the chapters on "Embryology."

The Musculature of the Gravid Uterus.—The muscular coat is formed of organic muscular fibres. Scarcely traceable during the non-gravid state, they become evident, "colossal," during gestation. Fig. 74 shows the nucleated fibres of the non-gravid uterus and the granular matrix in which they are embedded. During gestation these fibres grow in all their dimensions, and new fibres are formed, especially in the innermost layers of the middle coat. The production of new muscular fibres, says Kölliker, is chiefly seen during the first half of gestation. The extraordinary increase of size of the uterus under gravidity is chiefly due to the development of its muscular element. Kölliker has not observed the generation of muscular fibres after the sixth month. Corresponding with the growth of the muscular fibres, there is growth of the connective tissue which binds them together.

Fig. 74.

Muscular Fibres of Ute ru during gestation. (After Wagner.)

Ranvier says the muscular fibres not only grow, but they become towards the end of gestation striated, in a less marked degree, however, than in the proper striated muscles.

The hypertrophy of the muscular coat is very marked in the body of the uterus; less marked in the lower third, and scarcely appreciable on the neck, the fibres of which, although redder, scarcely increase in size. After labor these giant muscular fibres have to be disposed of. The uterus contracting permanently, the blood-supply attracted by the gestation-process is turned off, and the muscular fibres having accomplished their function pass into fatty degeneration. This process is the preparation for dissolution and absorption. Fig. 75 represents this granular conversion. The exact time required for the completion

Fig. 75.

Showing fatty degeneration of muscular fibres during involution after labor.

of involution is not certain. But since a new pregnancy may begin within two months, the uterus is probably reconstructed in less than that time.

The *disposition of the muscular fasciculi* is so intricate as to have led to much diversity of description. The admirable researches of Hélie seem to have

unravelled this complex piece of anatomy, and to have corrected and harmonized the descriptions of his predecessors.

Three layers constitute the muscular tissue. But fibres of one layer pass into the other coats, forming a network binding all the layers together.

1. THE EXTERNAL LAYER OF THE BODY OF THE UTERUS is composed of several planes of longitudinal and transverse fibres alternating with each other. The most superficial plane is longitudinal; it is formed of a median band (Sue, 1753); the middle part of this is curved loop-like over the fundus of the uterus, whilst its two ends descend, one over the anterior surface, the other over the posterior surface. It descends lower in front than behind. Behind it begins at the junction of the body and neck; it is formed below of transverse fibres, which, uniting, ascend vertically. As it ascends fresh fibres run into it from the sides. When it approaches the fundus, its lateral fibres curve outwards, and are directed over the Fallopian tubes and broad ligaments, in which they are lost.

FIG. 76.

EXTERNAL MUSCULAR COAT, ANTERIOR ASPECT. (After HELIE.)

This arrangement is seen in Fig. 76, which shows the anterior surface. The posterior surface it similar, but the central band does not descend so low (Fig. 77).

The middle fibres of the loop-like band alone turn over the fundus of the uterus. Some of the fibres from each side cross to the opposite side; but this is only partial, and is not constant.

This loop-like bundle is composed of two planes, separated by a layer of transverse fibres.

Next we have to study the transverse fibres, which, with the bundle just described, form the surface of the body of the uterus. These fibres (Sue, 1768) constitute the greater part of the external layer. Some help to form the loop-bundle; but most of them run transversely across the median line beneath the loop and between its planes; they are prolonged outwardly into the broad ligaments, and especially into the ligaments of the ovary, the round ligament, and the Fallopian tube.

If we trace the fibres in the opposite direction, they may be said to arise from all the above points, and leaving the side of the uterus, they part into two laminæ, one of which passes over the posterior aspect, the other over the

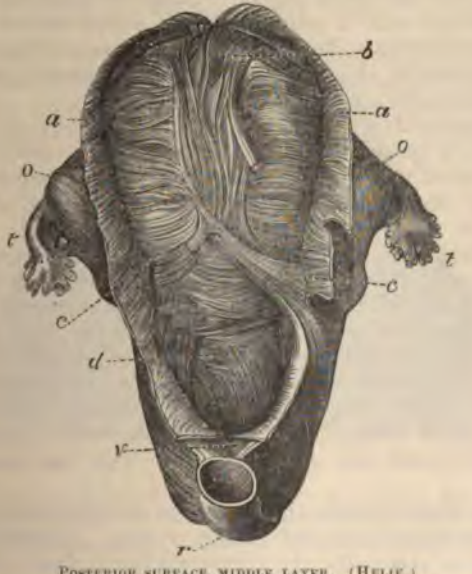
anterior aspect. Thus the uterus is embraced between two sheets of muscular tissue, running from the broad and other ligaments.

FIG. 77.

EXTERNAL LAYER, POSTERIOR SURFACE. (After HELIE.)

Fig. 78 shows the second or deeper plane. At the side of the uterus the transverse fibres are seen to pass on forming horizontal *circular* muscles.

FIG. 78.



POSTERIOR SURFACE, MIDDLE LAYER. (HELIE.)

a, *a*. Superficial transverse fibres thrown back. *b*. Loop-like fibres, continuous with *c*, the transverse. *d*. Fibres of neck. *o*, *o*. Ovaries. *r*. Rectum. *v*. Bladder. *t*, *t*. Tubes.

The course of these fibres is, however, very complicated. They diverge to let vessels pass; fibres, at first superficial, plunge deep.

Above the tubes and at their level, the disposition of the fibres is different. The transverse fibres describe large arches over the fundus. Some go to the tubes, round and broad ligaments, but the greater part descend along the side of the uterus. In their course they meet vessels which interfere with their regularity; then they plunge deeply, curving forwards or backwards to become transverse on one or other aspect of the uterus.

2. External Layer of the Cervix.—The hypertrophy is much less marked, the course is more simple. The fibres nearly all run a little obliquely downwards from the sides of the uterus towards the median line, where they cross the fibres from the opposite side. On the sides of the neck they turn round and pass from one aspect to the other. The most superficial are continued in front, with the vesico-uterine folds; behind, with the recto-uterine ligaments; below, with the fibres of the vagina.

3. The middle muscular layer is the thickest of all; but it only exists at the level of the body. There is no trace of it in the neck. It is distinguished by the great number of vessels it contains; and it is especially thick in the region which corresponds to the placenta. When the outer layers are dissected off it is seen that many of the fibres of these layers merge into the middle layer, there being no distinct demarcation between external and middle. It is composed of bands of variable size, which cross in all directions. Some are transverse, some oblique, some longitudinal; large apertures divide these bands from each other or the fibres of the same band. The muscular fibres coil round the uterine veins—the arciform fibres of W. Hunter (1772), and each loop crossed by another forms a complete ring surrounding the vein. A series of these rings forms a canal for the vein. Large rings like these surround several veins at once. Thus every vein is surrounded by annular contractile rings, and runs its course in a true contractile channel in the middle layer. This disposition is seen in Fig. 80.

The arteries, like the veins, are surrounded by muscular rings; but the arteries are provided with a cellular sheath, which allows them to glide in the rings, whilst the veins reduced to their inner coat adhere to the muscular fibres. The contractile rings not only close the vessels, preventing hemorrhage, but serve to some extent the office of valves.

4. The Internal Muscular Layer in the Body of the Uterus.—When the uterus is opened there is always seen in the middle of the posterior wall a slightly raised triangular bundle, whose base extends from one tube to the other, and whose apex descends to the os internum of the neck. This is seen in Fig. 79. This was described by Charles Bell. Near the tubal openings this triangular bundle divides into two thin fasciculi, which plunge on either side into the tube (Fig. 70, *c*, *d*). Transverse fibres, stretching directly across from one tubal orifice to the other, complete the triangle and form its base. A precisely similar triangle is found upon the anterior wall.

On the sides of these triangles, along the entire length of the body of the uterus, the muscular fibres of the inner layer run transversely, passing from one aspect to the other; they are, therefore, annular. At the os internum the transverse fibres form a ring-like bundle, which distinctly defines the cavity of the body and that of the cervix. This has been regarded as a sphincter.

At the fundus of the uterus—that is, above the tubal opening—fibres form arches, which constitute the roof of the uterus. Descending in front and behind, these fibres pass under the transverse band of the triangular bundle; there they bend to be lost in the horizontal fibres.

At the orifice of the tubes the fibres are arranged in concentric circles. One was described by Ruysch. Charles Bell recognized the two. Calza (1807) called them the *orbicular muscles of the tubes*. (See Fig. 79.) The

mode in which the vessels are encircled by muscular fibres is well demonstrated in Fig. 80.

Briefly the musculature of the uterus may be stated thus: 1. The texture is different in the body and in the neck. 2. In the body are found three layers: the *external*, with its loop-like bundle, its transverse fibres, whose

FIG. 79.

INTERNAL MUSCULAR LAYER. (HELIE.)

a. Section of uterine wall. *b*. Triangular bundle. *c*. Fibres running to the tubes. *d, d*. Orifices of tubes. *e, e*. Transverse fibres. *v*. Vagina.

ends are prolonged over the adnexa of the uterus, and its circular fibres; the *middle layer*, with its muscular bands, which describe loops and imperfect rings around the uterine vessels; the *inner layer*, with its two triangular bundles, its annular fibres around the tubal mouth. 3. At the *neck* there is

FIG. 80.

MIDDLE MUSCULAR LAYER AT FUNDUS, WHERE THE PLACENTA WAS SEATED. THE CROSSING FIBRES FORM RINGS AROUND THE VESSELS WHICH CONSTRICT THEM. (HELIE.)

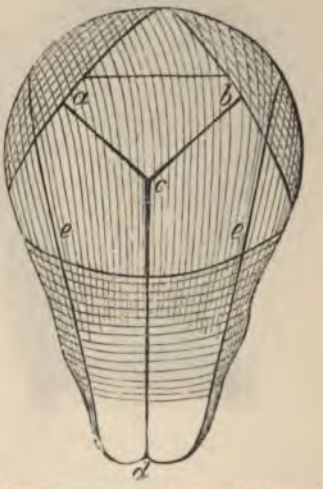
a, a. Superficial layer dissected back. *b*. Bundles belonging to the inner layer. *t, t*. Tubes.

the comparatively simple arrangement, two layers only being seen, which are continuous above with the external and internal layers of the body of the uterus. The fibres of the neck are mostly annular. The vaginal portion is almost entirely formed of the internal layer.

Action of the Muscular Wall.—Charles Bell says (1) there is a general prevalence of longitudinal fibres, the action of which would be to shorten the uterus, pull up the lower segment, and thus to expel the fœtus; (2) whilst the orbicular muscles of Ruysch, contracting concentrically, would lessen the area of the uterus, and thus cast off the placenta. (3) The ring-like arrangement of fibres around the vessels would act as ligatures and stop bleeding.

Dubois and Jacquemier insist that the muscular tissues of the uterus being divided into three layers, it is between the middle and external layers, or at

Fig. 81.



(Modified from Murphy) to represent actions of uterine musculature.

The muscles of the fundus at *a* and *b*, shortening concentrically, diminish the cavity towards *c*, and the resultant force, aided by the longitudinal fibres, thus tends to drive the fœtus downwards; the longitudinal fibres at the same time pull the cervix upwards upon the presenting part. The circular muscles open like a sphincter before the down-driven head; they contract as a sphincter when the cavity is emptied.

most in the middle layer, that the sinuses are found. Deprived of valves, these sinuses communicate so freely that they form a sort of cavernous organ in the uterus. In the neighborhood of the placenta many of these canals approach the internal layer; some even are separated from the mucous membrane only by a very thin stratum of muscular tissue.

Cruveilhier, by throwing injections into the vena portæ or the pelvic veins, proved that the pelvic, hemorrhoidal, internal pudic, and gluteal veins anastomose freely.

Chowne, also injecting the vena portæ, found the injection escape into the uterine cavity. This anatomical disposition and Chowne's experiments explain the occurrence of venous or retrograde hemorrhage from the uterus when its muscular coat is in a state of inertia.

The *peritoneal coat* of the uterus and its *mucous membrane* have been already described.

The Behavior of the Lower Segment of the Uterus and the Cervix during Gestation and Labor.

Levret and Baudelocque supposed that during the first four or five months of gestation the uterus was developed at the expense of its fundus and body; and that thenceforth the neck opening out from above downwards contrib-

uted to the enlargement of the uterine cavity. It was supposed that the fibres of the body contracting dragged upon the fibres of the neck, the rings of which opened successively from above downwards until nothing remained but the lower orifice; then labor would begin.

Roederer (1753) set forth the same doctrine as Levret. The elder Stein, Roederer's pupil, admitted simply a shortening of the cervix, not its opening.

Kilian (1839) contested this doctrine, and thought that the shortening was produced by swelling and thickening of the vaginal portion. He allowed that the cervix remained unaltered until the last four or five weeks of gestation, but that from that time it shortened from above. F. H. G. Birnbaum (1841) supported the views of his teacher (Kilian).

Stoltz (1826), went further still, and taught that the neck did not change in length throughout the course of gestation, unless during the last fourteen days. Caseaux, Scanzoni, Duncan, J. E. Taylor, Holst, Spiegelberg, P. Müller, Lott, and others adopted Stoltz's doctrine. Latterly Bandl,[1] A. Martin (1877), and W. Braune,[2] have shown grounds for rehabilitating in a modified form the old doctrine.

To explain the familiar fact of the lessening projection or flattening down of the vaginal portion towards the end of pregnancy, the advocates of the doctrine that the cervix remains unchanged have put forth many inconsistent theories. As Bandl says, these many explanations are sufficient to prove that the natural process of the opening of the uterus was but little known to them.

During the first four months of gestation the cervix undergoes little change. This is demonstrated in Fig. 84, drawn from the uterus of a woman who died in the fourth month of her second gestation, and still more clearly in Fig. 82, drawn from nature by Robert Barnes. This exhibits the lower segment and cervix uteri of a young woman who died by poison when about four months advanced in her first pregnancy. In this specimen the cervix is perfect; the os internum forms a sharp boundary between the body of the uterus and the cervical canal. The decidua is seen dissected up down to the edge of the os internum. Bandl, however, says that even at this epoch the lower segment of the uterus (Barnes, cervical zone) begins to be marked out from the body. In Fig. 84 the part between *a b* and *b' a'* is distinctly thinner and different in structure from the body of the uterus above. This will later become developed into a well-defined lower segment, as seen in the section (Fig. 83) of a uterus from a subject dying in the eighth month upon whom Cæsarean section was performed *post mortem*. Comparing this specimen with Fig. 84, the part *b a* is clearly distinguished from the body above *a*, by three features: (1) it is thinner, (2) the muscular structure is less marked, (3) it is less rich in vessels. The external layer of muscular fibres of the uterus hardly traced below the level of the insertion of the vagina; the vaginal portion shows only the inner muscular layer. This lower segment is divided from the body by a more or less well-marked ridge which goes all round the uterus. This is "*Bandl's ring.*" From this ring upwards the wall of the organ begins to be richer in vessels, the wide lacunæ of the middle layer begin, and corresponding to this line on the outer wall larger vascular trunks run in and out of the uterus. At this spot also one sees, when the uterus is *in situ*, the peritoneum investing the bladder, and Kohlrausch used this to fix the boundary between the body of the uterus and its cervix.

[1] Ueber das Verhalten des Uterus und Cervix in der Schwangerschaft und während der Geburt, 1876.

[2] Die Lage des Uterus und Fœtus am Ende der Schwangerschaft, 1872.

This boundary between the body of the uterus and its lower segment is easily felt in the living organ at the level of the pelvic brim. It may be always felt on introducing the hand to practise version, and often when the hand is introduced to remove the placenta. The contraction of the body of the uterus at this part gives the sensation of "hour-glass contraction."

FIG. 82.

THE CERVIX UTERI OF A PRIMAGRAVIDA AT FOUR MONTHS. THE CONSTRICTION AT THE ANTERIOR LIP OF THE OS EXTERNUM IS DUE TO A LIGATURE PLACED TO PRACTISE INJECTION. THIS WAS DONE BY SAMUEL LANE. ½ SIZE *ad nat.* (ROBERT BARNES.)

FIG. 83.

SECTION OF UTERUS AND CERVIX IN EIGHTH MONTH OF GESTATION. CÆSAREAN SECTION AFTER DEATH. (After BANDL.)

UC. Body of uterus. *a.* Bandl's ring. *b.* Os internum. *oe.* Os externum. *Vg.* Vagina. *Ul.* Lower uterine segment. *C.* Cervical mucous membrane. *d.* Connective tissue. *e.* Muscular layer. *b.* Seat of Muller's os internum. *a.* Seat of Braune's os internum.

A further distinction is seen in the different structure of the uterine wall in the two parts. In well-developed uteri one sees in section of preparations which have been some time steeped in alcohol, the middle layer of the body of the uterus ending in a point downwards between the outer and inner layer of the lower segment. (See Fig. 86.)

The formation of the lower segment begins at a date not exactly determined; but the walls are observed to become softer towards the seventh month. The very softened floor of the uterus, *a b, b' a'* (Fig. 85), together with the outer softened muscular layer of the cervix and vagina begins to yield, and the head or the ovum sinks in most cases with the softened floor more or less into the pelvis. The muscular tissues within the spaces *a b, b' a'* (Fig. 85), much softened, become elongated by the mechanical stretching of the on-pressing ovum or fœtal part. The uterus in Fig. 85 shows at the boundaries *a b, b' a'* the enlargement of this surface and the absorption of the outer layer of the cervix in the lower uterine segment. The section

(Fig. 83) shows plainly how with the ever-increasing development of the lower uterine segment this process is gradually achieved. During this process, the ovum not keeping pace with the expansion of the surface of the lower segment, the decidua is partly broken up; it is left in patches or sheds. Proceeding still further, the cervix yields more, and the cervical mucous membrane is found in parts on the lower segment. (See Figs. 83, *b*, 84, *b*.)

If we look at the figures we distinguish two rings: 1, the os internum of Müller, *b*; this is expanding to enlarge the cavity of the lower uterine segment; 2, the boundary between the body and lower segment of the uterus, *a*; this is the *second os internum* of Scanzoni, or Bandl's ring. The space

FIG. 84.

UTERUS OF WOMAN WHO DIED IN FOURTH MONTH OF SECOND PREGNANCY. CERVIX AS YET QUITE UNCHANGED. (After BANDL.)

4.5 cm. long; 1.5 cm. thick. Two layers distinctly seen; one tougher, of connective tissue, near the mucous membrane (*d*), and one softer, muscular (*c*), connected with the uterus above, with the vagina below. *a b*, *b' a'*. Seat of formation of the lower uterine segment.

between these two rings is the canal of Braune. This canal is later lengthened by the taking in of a portion of the cervix.

Fig. 86 shows the condition of the uterus at term after labor. The cervix has greatly emerged into the lower segment, and a rent is seen through its mucous membrane from the os externum to the os internum.

As to the neck itself diminishing in length as the cervico-uterine canal is formed, its muscular coat participates, to the exclusion of the mucous coat, in the formation of this canal. The cervical mucous membrane, lined by the connective tissue which sustains it, yields and slides on the muscular layer. It thus forms imbricated folds, and the os internum formed by this mucous membrane comes near to the os externum. This explains how the neck seems to be, at the end of gestation, only 1 or 2 centimetres long. Tarnier points out that this doctrine of Bandl is analogous to that of Jacquemier, and still more to that of the older authors Levret and Petit, who admitted that the neck was gradually absorbed by the body during the later months of gestation.

When we come to describe the physiology of placenta prævia we shall see

how strikingly these researches of Braune, Müller, and Bandl illustrate and confirm Robert Barnes's theory of that event. It will then be seen that he had anticipated by clinical observation and physiological reasoning the discovery of the distinction between the lower segment of the uterus and its body, and that he had closely mapped out its extent and boundary.

FIG. 85.

UTERUS OF A 2-PARA, WHO DIED IN EIGHTH MONTH. CÆSAREAN SECTION POST MORTEM. (After BANDL.)

a. Body of uterus, distinguished from lower part by its thicker wall. *b*. Lower segment of uterus, distinguished by thinner wall, softer consistence. *C*. Mucous membrane of cervix with well-defined limit above and below. *oe*. Os externum. *V*. Vagina. *Ll*. Broad ligament. *p*, *p*. Peritoneum. *us*. Lower uterine segment. *a*, *a'*. Seat of Braune's os internum. *b*, *b'*. Seat of Müller's os internum.

THE CERVICAL CANAL IN GESTATION AND LABOR.—The cervix, as already noted, scarcely grows during gestation. It does, however, increase a little. The *shape* must be observed in the different epochs of gestation, and contrasted in primigravidæ and plurigravidæ. Until the middle of the ninth month the changes of shape are slight. During the last fortnight of gestation the change is very important.

In primigravidæ, until the last month, the neck becomes more conical, the apex being represented by the os externum. Soon the middle part of the cervical cone expands a little, so as to represent an elongated spindle. (See Fig. 82.) This depends upon the accumulation of viscid mucus. In multiparæ the canal also contains thick mucus, but the neck, instead of being spindle-shaped, remains cylindrical; and often the *os tincæ* softening assumes the shape of a club, hollowed at the level of the os externum.

In the primigravida the os externum commonly remains smooth, more or less rounded; in the pluripara, it is commonly lobed, jagged, divided more on one side, commonly the left, than the other, and more open. The cervix rises nearer to the sacral promontory during the first months of gestation. (See "Diagnosis of Gestation.") The body of the uterus being deviated to the right, the neck necessarily in rising turns to the left.

Softening begins early. It is first observed at the tip of the vaginal portion, affecting only the superficial layer. As gestation advances the soften-

ing invades in successive layers the whole length of the neck up to the os internum. That is, *the softening proceeds from below upwards*—from the os externum to the os internum. In the primigravida the supravaginal portion softens in the ninth month. In the multipara, the softening proceeds more rapidly, previous gestations having prepared the way.

FIG. 86.

UTERUS OF A 1-PARA, WHO DIED TWELVE HOURS AFTER LABOR AT TERM. (After BANDL.)

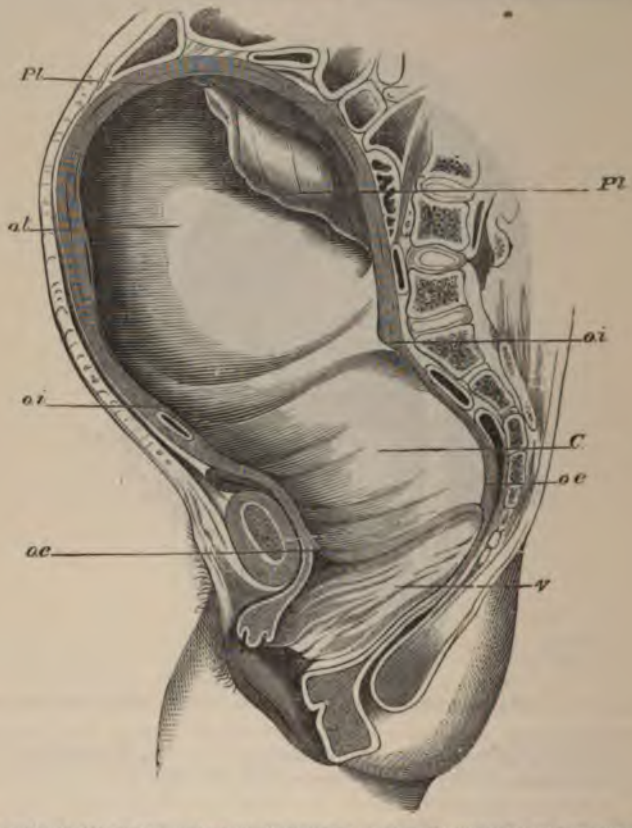
m. Lower uterine segment. *a*, *a'*. Seat of os internum in Braune's drawing. *b*, *b'*. Seat of Müller's os internum. *a b*, *b' a*. Lower uterine segment. *o e*. Os externum. *C*. Cervical mucous membrane. *Li* Ligaments. *p*, *p'*. Peritoneum, borders of. The cervix from *o* to *b* is seen cleft.

OBLITERATION.—Since Stoltz's researches it is recognized that the neck does not change in length before the last fifteen days of gestation. But in the last fifteen days there is a real obliteration; the neck shortens by opening up *from above downwards*, so that at last it is reduced to its os externum. The process is as follows: first, the os internum, then the parts of the canal below successively open out, becoming lost in the cavity of the body of the uterus. When the obliteration is complete the uterus and cervix form but one cavity, of ovoid shape, pierced below by the os externum. It will be seen that the os internum does not approach the os externum. The opinion held by some that the os externum opens first, and that the finger passing this is arrested by the os internum, is illusory. In multiparæ the os externum is more gaping and soft, so that the finger easily passes it, but nevertheless the natural process is that expansion begins above.

After labor the neck is reconstituted—that is, the os internum is plainly marked, whilst the os externum remains so largely expanded as hardly to be recognized. The obliteration of the latter half of the last month is due to the painless contractions of the uterus acting upon the softened tissues.

It must be noted that the softening and the obliteration follow an inverse order. Softening proceeds from below upwards, obliteration from above downwards.

FIG. 87.



SECTION OF GENITAL CANAL AFTER REMOVAL OF CHILD, SHOWING THE CANALIZATION OF THE CERVIX AND THE CANAL OF BRAUNE.

Pl. Placenta. *o. t.* Tubal orifice. *o. i.* Os internum. *C.* Cervix. *o. e.* Os externum. *v.* Vagina.

The following table, from Tarnier, gives approximately the differential modifications of the cervix uteri in primigravidæ and plurigravidæ:

State of the Neck.	Primigravidæ.	Plurigravidæ.
Form of neck down to 8½ months.	Fusiform	Cylindrical or club-shaped.
Os externum down to 8½ months.	Closed, regular, oval, or rounded.	Gaping, irregular, jagged, and everted.
Canal down to 8½ months.	Elongated spindle .	Thimble-, funnel-, or extinguisher-shaped.
Os internum down to 8½ months.	Closed	Usually closed; sometimes open, especially in women who have had many children.
External orifice at term.	Closed and defined by thin lips, tight and regular.	Open and defined by thick lips, soft and irregular.

Modifications of the Serous Coat.—At term the serous coat of the uterus has the same aspect and thickness as before impregnation, although the superficies of the uterus has increased twenty-fold. How is this explained? It has been supposed that the folds of the broad ligaments and the looser peritoneum around the lower segment of the uterus, unfolded and carried upwards, formed a covering for the growing uterus. But the fact is that the broad ligaments are not equal to this task. The sliding of the peritoneum is in reality not great, and it must be limited to the lower segment. The body and fundus, therefore, depend for a peritoneal investment upon the continuous growth of this membrane.

Sometimes, however, the peritoneum failing to keep pace with the development of the uterus splits, and cracks are seen after labor.

The Vagina in Gestation.—The vagina becomes more lax, distensible, and freely lubricated with mucus and serous fluid. It undergoes changes of form and relation during the progress of gestation. The principal of these will be appreciated on studying the figures representing the positions of the uterus at the several stages. At first the vagina is lengthened and directed somewhat more backwards by the anteversion of the uterus, by which the cervix is carried upwards and backwards. Towards the end of gestation the vagina is shortened, squatting, by the descent of the uterus into the pelvis. The vagina, like the uterus, undergoes physiological hypertrophy of all its tissues. That it gains in muscular tissue seems proved by the marked contractile power sometimes manifested during the expulsion of the placenta and afterwards. It undergoes a process of involution after labor. The rugæ are less marked after labor than in the virgin and nulliparous woman.

The Vessels and Nerves of the Gravid Uterus.—The vessels grow under the developmental stimulus in a remarkable manner; vessels not before to be seen come into prominence, and assume quite new characters.

The *arteries* increase greatly in volume, the branches even more than the trunks. The uterine arteries on arriving at the borders of the uterus, instead of becoming smaller, are notably enlarged. The branches springing in turn from these exceed in size the arteries which supplied them. Not only do they grow in volume, but they grow in length in order to keep pace with the development of the uterus. And what proves that the elongation is the result of hypertrophy is the fact that they are not less tortuous than in the non-gravid state. The numerous divisions which run to the uterus form in the superficial layer a vast network of their branches, which results not alone from the frequent anastomoses between the ovarian and uterine arteries of the same side, but also from anastomoses between the arteries of opposite sides. Amongst these anastomoses, there may be seen right and left a large branch running from the uterine artery of either side to the ovarian artery of the same side. This branch, bigger than the radial, runs nearly parallel with the epigastric artery. Glénard describes it as the *puerperal artery*, and regards it as the habitual seat of the uterine souffle.

From all these anastomoses branches part which penetrate the uterine tissue, coursing through it in every part. The divisions which correspond to the insertion of the placenta are, however, bigger than the rest. A number of ramuscules reach the inner surface of the uterus and subdivide in the mucous membrane, where they terminate. Those which are distributed in the uterine decidua are extremely delicate and short, those which are distributed in the serotina are larger and longer. They are the *utero-placental arteries*. Bloxam ("Med.-Chir. Trans.") showed that these arteries also are tortuous or helicine.

A very thin cellular sheath accompanies the uterine arteries, and their

walls are not confounded intimately with the muscular tissue in which they run, as is the case with the veins.

The artificial ramifications are continuous with the *capillaries*, which in their turn give rise to the veins. The uterine capillaries, says Jacquemier, do not differ from those in other tissues, unless it be that they are more permeable to injections. They enlarge during gestation. This disposition explains the activity of the uterine circulation, and the rapidity with which the blood may pass from the arteries into the venous sinuses.

The veins increase enormously in size. The ovarian veins become nearly as large as the internal or external iliacs. In the walls of the uterus the venous system is constituted by large canals or sinuses communicating with each other; they are seated in the middle layer, about equidistant from the inner and the outer surface. The community of these anastomosed canals forms a plexus, several of the divisions of which are as big as the little finger.

These canals are much larger and more numerous in that part of the uterine wall which corresponds to the placenta. They diminish as they part from the circumference of this organ. At the circumference a large number of venous canals or sinuses approach the inner surface, most of them running obliquely; they course for a certain distance on the inner surface of the uterus, covered within by a very thin lamina of muscular tissue, or simply by the mucous membrane, then they penetrate the serotina, and between the lobes of placental cotyledons. These are the *utero-placental veins.*

The venous plexus, situated in the middle muscular layer, receives a large number of venous radicles proceeding from the external layer or from the internal layer, or from the decidua itself. This disposition is strikingly analogous to the manner in which the veins of the brain and its membranes are disposed in relation to the sinuses of the dura mater.

The uterine sinuses appear to be reduced to their serous tunic, which, by its outer surface, adheres intimately to the muscular tissue. They are, therefore, true contractile canals. The uterine veins are destitute of valves. Injections thrown into the trunks penetrate in all directions. The muscular fibres which surround the canals perform the function of valves.

Dr. Graves illustrated his hypothesis of the independent or innate character of the capillary circulation by reference to the gravid uterus. "Here we see not only vessels innumerable, but nerves developed without any increased *vis à tergo*, and the nerves like the vessels formed from the circumference to the centre." Although a *vis à tergo* certainly does work in the development of capillaries, there is as certainly a *vis à fronte*, or *in loco*, contributing to the increase of capillary growth. The history of early embryology supplies evidence in favor of this hypothesis.

Reimann ("Arch. f. Gynäkol.," 1871) concluded that the uterus, like the heart, had nervous centres independent of the cerebro-spinal system. He removed the uterus of bitches and cats from the body, and found that he could excite rhythmical movements by electricity, as in the heart.

The *lymphatic vessels* increase greatly. Cruikshank pointed out that they are as large as goose-quills, and so numerous that when injected with mercury one might be tempted to believe that the uterus was a tissue of lymphatic vessels. These vessels often present bulgings described by Cruveilhier. Fig. 54 represents the lymphatic system. The study of it is especially important in relation to the history of involution and septicæmia after parturition.

The *nerves* of the uterus, like all other tissues, undergo enlargement during gestation. Whether or not we admit the accuracy of the descriptions of Robert Lee, we are driven by physiological reasoning to conclude that the

contractile property of the uterus depends upon nervous energy; and that nerve-force is generated in enormous quantity for the purpose. And nerve-force is the product of nerve-tissue.

The Changes, Structural and Functional, arising in Gestation Considered in their Togetherhood.—If we gather into one focus all the phenomena evoked by gestation, we cannot fail to be impressed by the marvellous transformation wrought in every part of the organism. Every drop of liquid, every cell, every fibre, every organ feels the new impulse. All are compelled to work together to carry out the work of reproduction. Every function is doubled in energy and sphere of action. The impregnated woman digests, assimilates, her heart beats, she breathes, excretes for two beings. Healthy gestation is marked by exact equilibrium between the wants of the two organisms. But in truth the imperious demands of the new being often predominate. The maternal organism in its struggle to keep pace with the absorbing exactions of the embryo is severely taxed. The two functions which most conspicuously answer to the call are those of the nervous and vascular systems. These in their actions and reactions respond to and conduct the developmental processes in the uterus and the correlated processes throughout the body. The exalted nerve and vascular tension induced underlie all the vital processes alike—those which keep within the due physiological equilibrium, and those which breaking bounds manifest themselves in pathological deviations. The organs, separately and conjointly, are working under high pressure. If all are sound, and if no extraordinary trial be imposed from external sources, they will work smoothly under the natural regulating forces to their end. Gestation may thus be said to be a great experiment instituted by nature. In a memoir on "The Relations of Pregnancy to General Pathology," in the "American Gynæcological Transactions," Robert Barnes insisted that the study of gestation could not fail to illustrate and solve many problems in pathology. "Diseases"—such as those which lead to albuminuria, for example—"that are slowly, by imperceptible degrees produced in man, may be almost suddenly induced or initiated under the definite conditions that justify a precise conclusion when an experiment *ad hoc* is performed. For what can more nearly resemble a scientific experiment than to take a healthy woman, to induce pregnancy, and then to observe and to record the effects of this change upon the economy? In the whole range of medicine there is nothing to compare for breadth of information with the opportunities thus presented to us by this natural experiment."

Gestation tests the integrity of every structure in the body. Under this test a weak organ or constitution hitherto working fairly and sufficiently reveals its defects, and by its work shows the development of processes which, under other circumstances, are regarded as pathological.

The phenomena of healthy gestation, lightly sketched in this chapter, will be further illustrated in the chapters on the "Diagnosis of Gestation," on the "Diseases of Gestation," and on "Abortion." We shall then see how intimately the two processes are connected. These chapters should be read consecutively. We shall then appreciate the cardinal truth that the so-called diseases of gestation are for the most part simple exaggerations of physiological conditions, that almost every disease has its foundation in an antecedent correlated process. We shall see that the transition from physiology to pathology and back again is wonderfully rapid; that often the boundary can hardly be defined; that although the mind revolts against the dictum of Mauriceau that gestation is a disease of nine months' duration, the dictum of Boerhaave, "Femina plurimis afficitur malis ex solâ graviditate oriundis," is true.

by gravity. Scanzoni united several of the hypotheses affirming that head presentation is the result of multiple causes—as gravity, the form of the uterine cavity, the form of the fœtus, the quantity of liquor amnii, the contractions of the uterus, and even active movements of the fœtus.

The gravitation theory has been disposed of. It is based upon the vertical attitude of the woman, which is not constant. It assumes that the fœtus is suspended by the umbilical cord, and that the head-end being relatively heavier in the early months, it must fall towards the lower segment of the uterus. But the cord is really too long to serve for this suspension. Hydrocephalic fœtuses rarely present by the head; anencephalous fœtuses often do. Dead and premature children often present by the breech.

The relation of the fœtus to the uterine cavity is in reality the resultant of several factors of a law of accommodation. Pajot[1] thus formulates *the law of accommodatian in labor: "When a solid body is contained in another, if the containing is the seat of alterations of movements and repose, if the surfaces are slippery and only slightly angular, the contained will constantly tend to accommodate its forms and dimensions to the forms and capacity of the containing. The presentations and positions of the fœtus in pelves normal or faulty are governed by this law."*

A similar law of accommodation governs the positions and presentations of the fœtus *in utero* during pregnancy and labor. In the early stages of pregnancy the embryo is so small relatively to the uterine cavity that it floats suspended in the liquor amnii. But about the middle of pregnancy the fœtus grows rapidly, it acquires form, and at the same time the uterus grows more in its longitudinal than in its transverse diameter. As soon, therefore, as the fœtus—an ovoid body—attains a size which approaches that of the capacity of the uterus, the walls of the uterus—the containing body—will impose upon the fœtus a vertical position. Mutual adaptation requires that the long diameters of fœtus and uterus shall coincide. This is one factor in the accommodation.

Then, it is now admitted that during the first six months the upper segment or fundus of the uterus is more developed than the lower segment. Moreover, during this time the head is the biggest part of the fœtus. Throughout gestation painless contractions of the uterus take place, and when the uterus contracts the transverse diameters are shortened, whilst the long diameters increase. These are the alterations of movement and repose. During the first two trimestria the fœtus enjoys a certain freedom of movement, and it is easy to make it turn about; but after a while it recovers its situation. This is because the capacity of the uterus is much greater than the volume of the fœtus; and thus the necessity of accommodation is not so imperative as it becomes later on.

During the last trimestrium the lower segment of the uterus is more capacious than the upper, and hence the breech or bigger end of the fœtal ovoid is lodged there. This is a second factor in the accommodation. Robert Barnes pointed out another reason why the head should present. The fundus, or at least the upper segment, of the uterus is the part designed for the attachment of the placenta. There it can grow undisturbed and continue free from injurious pressure during the expulsion of the child. The bulk of the placenta then added to the breech requires the region of greatest space—the upper segment. This is another factor determining the downward position of the head.

There is a condition to which Robert Barnes[2] drew attention as directly

[1] Art. "Accouchement," Diction. Encyclop. des Sc. Méd.
[2] Obstetric Operations.

influencing the position of the fœtus. The preceding factors account for the coincidence of the long diameters of fœtus and uterus, and for the position of the head downwards. Why is the transverse diameter of the fœtus usually coincident or nearly so with the transverse diameter of the uterus? Why is the back of the fœtus most commonly turned forwards? The law of mechanical accommodation gives the answer: 'The uterus is normally somewhat flattened in the antero-posterior diameter. In the non-pregnant uterus the cavity of the body—the true and only gestation-cavity—is a flat triangular space, the angles of which are the orifices of the Fallopian tubes and the os uteri internum. A similar triangular superficies is marked out on each half of the uterus, anterior and posterior. The anterior superficies lies flat against the posterior superficies. When pregnancy supervenes these surfaces are necessarily separated to form a cavity for the growth of the ovum. But the original form is never entirely lost. The cavity is always more contracted from before backwards than from side to side. The uterine cavity after labor is closed" [not only by shortening, but also] "by the flattening of the anterior and posterior walls together. Now this flattened form of the uterus is the cause of the fœtus taking a position with either the belly or the back forwards. The fœtus is broader across the shoulders than from back to front, and therefore its transverse diameter is fitted to the transverse diameter of the uterus."

Why is the back usually turned forwards? The child's back is firm and convex, its head is also firm and convex behind. The anterior surface is plastic and concave, and therefore fits better to the firm convexity of the mother's spine. Under the movements of the uterus, the convex spine of the child being movable will necessarily move away from the convexity of the mother's spine and adjust itself to the anterior wall of the uterus, which has ample facility for expansion by pushing out the yielding abdominal wall. This is another factor in the accommodation.

3. The Relations of the Gravid Uterus to the Abdominal and Pelvic Cavities.—These, again, are governed by the law of accommodation. Let us see first what takes place in primigravidæ. The uterine sac becomes extremely mobile as it rises into the large abdominal cavity; its attachments, which admit of considerable displacements in the pelvic cavity, lose almost all influence upon the uterus in the abdominal cavity, excepting perhaps the round ligaments, which exercise a little action. It floats in the abdominal cavity; its lower segment is found at the upper part of the excavation. In proportion as the uterus and its contents develop, the pressure which the abdominal walls sustain increases, so that at a given moment the indirect action of the diaphragm making itself felt, the abdominal cavity becoming too small, the uterus is forced to descend into the pelvic excavation, hitherto empty. But it descends with a fœtal part, the flexed cephalic extremity. For other parts to enter, energetic contractions are needed, such as occur only during labor.

In multiparæ things are different. The abdominal wall has been distended, its cavity is much larger. The uterus is no longer supported; its long axis becomes oblique, diagonally disposed, or the fundus falls forwards, the belly is pendulous, the uterus in anteflexion. The fœtal axis, although still corresponding with the uterine axis, is no longer coincident with the pelvic axis. The lower segment of the uterus remains at the level of the pelvic brim, the neck is less accessible, the fœtal part is not driven into the pelvis, and uterine contraction does not always suffice to restore the long axis of the median line.

In these conditions, displacement of the fœtus is easy. Hence abnormal presentations. These are much more frequent in multiparæ than in primiparæ.

Another factor has been already explained—namely, the adaptation of the

posterior wall of the uterus and the abdominal aspect of the fœtus to the mother's spine.

4. The Accommodation of the Fœtal Head in the Pelvic Cavity during Gestation.—In penetrating the excavation during the last three months of gestation in primiparæ, and during the last month or fortnight in multiparæ, the head undergoes a new accommodation according to a strictly mathematical formula. It obeys the influence of the abdominal and pelvic cavities which contain it. To enter the lesser pelvis it is forced to bend in order to adjust its smaller diameters to the pelvis. Dubois observed that of 1913 vertex presentations, 1355 were left anterior occipito-iliac; 491 right posterior occipito-iliac; 55 right anterior occipito-iliac; and 12 left posterior occipito-iliac. That is, the long diameters of the head were always found in relation with the oblique diameter of the pelvis; and of these two, the left or larger was engaged 1886 times to 77 times of the right oblique.

Hence, to resume. During the first six months the situation of the fœtus in the uterine cavity is not fixed, but most frequently the cephalic end occupies the fundus.

During the last three months the cephalic end most frequently gains the inferior segment of the uterus, remains there, and enters the pelvic excavation.

The changes of presentation and position depend upon the defect of one or more of the factors of accommodation.

Plural or Multiple Gestations.

Veit[1] has analyzed a large collection of cases with a view to determine the relative frequency of multiple births, Of 13,360,575 labors, there were 149,964 twin-gestations; triplets occurred 1649 times; quadruplets, 36 times. The proportion of multiple births was 1 in 88; of twins, 1 in 89; of triplets, 1 in 7910; of quadruplets, 1 in 371,126. Thus the rarity in the number of children born of one gestation increases at a very rapid ratio. Examples of quintuplets are amongst the curiosities of obstetrics. But well-authenticated cases are recorded. Thus Hull, Chambon, Ramsbotham, Puech, Volkmann, and McClintock each relate one.

The relative frequency of plural gestations appears to vary in *different countries* and *races*. In England, twin-gestation occurs about 1 in 80. It has been imagined that it may depend upon the *energy of the ovary* in the individual. Thus it has been more often observed in women who have had many pregnancies. It is certain that there is an *individual proclivity* to multiple gestation. Many instances are known of women who have several times successively brought forth twins or triplets. A more doubtful point is *paternal influence*. Are certain men endowed with the faculty of procreating more than one child at a time? There is the instance cited by Velpeau of the Russian peasant Wasilew, whose first wife had quadruplets four times, triplets three times, and twins sixteen times! The second wife had triplets twice and twins six times, so that this patriarch had eighty-four living children out of eighty-seven which he had begotten! It requires a robust faith to accept this marvellous story. But Leroy cites the case of four brothers in whose family twin pregnancies had been observed in collateral relations. Three of these brothers had twins twice, and the fourth four times. It is far more probable that the fertilization of more than one ovum at a time depends upon the ovary evolving two or more ova together. There is evidence to show that multiparity is to a certain extent *hereditary*. This unhappy addition to the burthen of maternity is known to reappear in

[1] Monatsschr. f. Geburtskunde, 1856.

successive generations. Has the *age* of the parents any influence? We have known several examples of twins in first gestations in young couples.

THEORIES OF MULTIPARITY.—1. Two or more Graafian follicles may burst at the same time, each yielding an ovum to be fecundated. 2. Two ovules may exist in the same vesicle, and being extruded together both may be fecundated. 3. One ovule may contain two germs. This latter event would explain what is called *fœtal inclusion*. The *ovum in ova* is not rare in birds. There are specimens in the Hunterian Museum, and Robert Barnes exhibited a remarkable specimen of a perfect ovum with its shell included within another shell which contained its own perfect ovum. It is figured in the "Obstetrical Transactions," 1863. We have seen in the Munich Museum the chest of an officer containing a developed fœtus. This is a clear case of "fœtal inclusion."

Then there is (4) The theory of *superimpregnation*. This implies that the ovules may be fecundated by two separate acts of copulation at a greater or less interval of time; or else that ovules extruded at different times may be fecundated by the same coitus. This is divided into *superfecundation* and *superfœtation*.

(A) *Superfecundation*.—There are examples of negresses, who, having had sexual relations with a black and a white man within the *same ovulation period*, have brought forth twins, black and mulatto; and converse examples are related of white women, who under similar conditions have brought forth a white and a mulatto. Buffon, Dewees, Dunglison, Beck, testify to facts of children of different races being born. Dr. Henry, in his excellent essay on superfœtation, quotes a case which occurred in the Brazils, where the indigenous race is copper-colored, but where there are whites and negroes. A creole woman had three children at a birth—white, brown, and black—with all the features of the respective races.

It is probable, says Tyler Smith,[1] that in many cases of twin pregnancy, the second ovum has been fecundated by a coitus occurring subsequently to the first impregnation. In rare instances, in twins, the placenta is found to be single. It may be that these are cases in which one ovule has contained two yolks and two germinal vesicles, just as we sometimes see in birds, one egg with a double yolk, producing two individuals. In these cases, the twin impregnation must occur at the same time. More frequently the placenta and membranes are double, but the placentæ are side by side, and in these cases two separate ovules have probably descended from the same ovary, and have been impregnated at the same, or at different times. In some cases the placentæ are attached to opposite sides of the fundus uteri, the inference being that the ova have descended from the two ovaries, but they may have been impregnated by a single coitus or otherwise. In all these cases the fecundation occurs within a short space of time (within the same "ovulation period"), and the same preparation of the uterus serves for the twin fecundation.

Physiological experiments support these observations. A mare covered by two horses of different races has brought forth foals corresponding to the two races. Similar observations are related of dogs. A mare covered by a horse and by a donkey has produced a horse and a mule; and that when there had been an interval of from one to sixteen days between the two fecundations.

(B) *Superfœtation*.—For this to take place two conditions must concur. (1) The sperm must find its way between the decidua reflexa and the decidua uterina, thence into the tube. (2) During gestation an ovule must be de-

[1] Manual of Obstetrics, 1858.

tached from the ovary and be received into the tube. Theoretically, both these conditions are possible. For some weeks after gestation there remains a decidual cavity, with free access from the cervix uteri in at least one tube, and ovulation certainly, in some cases, goes on.

What is the evidence bearing upon this question?

(1) Cases—they are not rare—are observed of the *expulsion at the same time of two fœtuses of unequal development.* These cases must first of all be divided into two classes: (*a*) those in which one fœtus is alive or only recently dead, the other having obviously perished long before labor; (*b*) those in which both children are born alive or after recent death of one or both.

(*a*) To this class belong the rather numerous cases of twins of which *one child is born well developed* and vigorous, the *other small, dead, shrivelled up,* having obviously been retained a long time after its death. There is an excellent illustration of this event in Cruveilhier's "Anatomie pathologique." A seven months' child is connected with a fresh working placenta, a small mummified fœtus of about four months' development is attached to an atrophied placenta. The two placentas are united, therefore, the result of one impregnation. We are compelled, however, to dissent from the interpretation of the great master. He attributes the death of the dried fœtus to atrophy of the placenta. Our own researches leave us in no doubt that the change in the placenta was consequent upon the death of the embryo. Several museums in the London hospitals present similar cases. From time to time cases of this kind are brought forward as proofs of superfœtation. The fallacy of this evidence is obvious. The true interpretation is as follows: There is an original twin-fecundation; one embryo is developed faster than its fellow, or is more favorably accommodated in the uterus. Continuing to grow by virtue of the right of the stronger, or, as it may be expressed, by the "selection of the fittest," it gradually compresses its brother or sister with the placenta, killing it. Then the developmental stimulus, created by its own need continuing to act upon the uterus and organism, its development goes on, its fellow being locked up, preserved from putrefaction by a process of adipocerous conversion, waiting until its fratricidal brother is ripe for birth. Then both are expelled together. These cases then do not sustain the theory of superfœtation.

(*b*) Cases of twins both alive of different stages of development, or one only recently dead, born either at nearly the same time or within a considerable interval. Naegelé, of Düsseldorf, relates the following case: A woman was delivered on June 22, 1857, at 9 P. M., of a large and vigorous girl, and half an hour afterwards of a second girl, very small, which uttered a few feeble cries, could not take the breast, and died at the end of fifteen days. Its cranial bones were soft, the fontanelles large; the nails imperfectly developed. Dr. Klykpennink, of Aalten, Holland, relates this: On May 2, 1835, a woman was delivered of triplets; the first still gave signs of life when it was born; it was well formed, developed to 4½ months; the second was expelled next day at 6 P. M.; it had ceased to live some days, and appeared of the same age as the first; the third was at term, living at its birth, but died in a few days. Some analogous cases are recorded, one by Dr. Boyson ("Western Lancet," 1879). These cases are not convincing. It is in a high degree improbable that fecundation can take place through a uterus in the fourth month of gestation when the decidual cavity is usually closed, and access to the tubal orifices is blocked. We would rather believe that all the embryos were fecundated together, and that the development of one was retarded by the superior vitality of the other.

Then there are the cases *of two living and viable children born at distant epochs.* Passing by cases of ancient date which cannot now be subjected to

criticism, we cite one by Fordyce Barker, who relates that a woman gave birth on July 10, 1855, to a boy well made and apparently at term; on September 22—that is, seventy-three days later, she gave birth to a girl, also alive, but smaller. In this case a bifid uterus existed. It may be contended that impregnation may take place at distant intervals through the two uteri. *The theory of double uterus* offers the explanation most consistent with well-attested facts and with precise physiological knowledge. Still cases are cited in which the uterus was alleged to be single.

Cases of superfœtation beyond all doubt are those in which *uterine gestation follows upon an extrauterine gestation.* Such cases are not very rare. There are examples of women going through two or more uterine gestations, an extrauterine gestation existing all through. But these cases do not touch the theories of twin intrauterine gestation.

The ordinary *history of twin gestation* is of great practical clinical interest. It is desirable to understand the varieties that occur. (1) Each fœtus may be contained in its own complete fruit-sac—that is, there are two amnions, two chorions, two placentas; each fœtus has its own distinct circulation. In some cases of this class, the placentas grow apart from each other, and are extracted each entire, one after the other. In these cases, there can be no doubt that two ova came down either from one ovary, or one from each ovary, and were fecundated, either at the same time or within the same ovulation period. Two corpora lutea have been seen in some cases of this kind. The children, having a distinct origin, may be either of the same sex or of different sexes. As in single births, male children predominate. In these cases the two ova approaching each other, the intervening decidual coats may be absorbed. Then the fœtuses are only parted by four sheets, two amnions and two chorions. Thus distinct, one fœtus may be expelled some days after the other. Of this event, examples are not rare. To cite one or two:

Dr. Baranski ("Centralbl. f. med. Wissensch.," 1881) relates that a woman was delivered of a boy a little before term; the placenta was extracted in the ordinary time. She went back to her work. Seventeen days afterwards, while working in the fields, a copious flow of liquor amnii set in, without pain. Dr. Baranski called in, found an arm prolapsed; he delivered her of a well-developed child showing no trace of maceration; the placenta followed in some minutes.

Steele, of Liverpool, found a second child presenting in unruptured membranes twenty-two hours after birth of first child. He ruptured the membranes. The woman had been walking about without pain. The placentas were distinct.

(2) *The two fœtuses may be enclosed in the same chorion;* each, however, has its own amnion. The placentas are united, forming one mass, but the circulations are usually distinct—that is, there is no interplacental anastomosis; each fœtus has its own district in the placenta; there are two distinct umbilical cords. Each placental district may be injected separately.

It may be supposed that the two ova, originally distinct, came into contact, and that under mutual pressure the chorions at the seat of contact became absorbed.

In such a case, one fœtus may perish, and be retained until the other has arrived at term. But if one is expelled, the other must soon follow.

(3) *The two fœtuses may be contained in the same amnion.* There is one placenta; the circulations are often common; sometimes there are two distinct cords, sometimes one which divides. Each embryo has originally its own amnion, but these at the point of contact may be absorbed, and so fused into one sac.

When the two fœtuses are included in the same fruit-sac they generally, if not always, are of the same sex. In the cases of united twins, as the Siamese, they are, without exception we believe, of the same sex. When the fœtuses are enclosed in the same amniotic sac the cords are apt to get entangled. P. Müller[1] found four cases recorded of twistings of the cord, and two of knotting—namely, by Tiedemann, Stein, Osiander, Sammhammer, Soete, and Newman. The last case deserves to be cited. Dr. Newman relates[2] that two fœtuses were enclosed in the same sac. From the centre of the solitary placenta sprang two cords. The cord of the first child presented at its middle a knot; the cord of the second passed through this knot and was so compressed that the cord was strangled. The two children were at term; the one whose cord was knotted was alive, the other dead. A singular instance of fratricide *in utero!* In these cases it is probable that one ovum only was originally fertilized, and that it divided.

Spaeth, who made elaborate studies regarding twins, found, in 185 cases, the placentas separate with two chorions and two amnions, forty-nine times; placentas united, with two chorions and two amnions, forty-six times; placentas united, one chorion and two amnions, twenty-eight times: placentas united, one chorion and one amnion, in two cases. When the chorion was double he never found in the united placentæ any anastomosis between the vascular districts of the two umbilical cords, even when no line of demarcation could be discovered between them. Anastomosis was found in both cases where with one chorion one amnion existed; and out of the twenty-eight cases of one chorion and two amnions, anastomosis was met with seventeen times. In every case the anastomosis took place by thick vascular branches (Naegelé); it lay quite superficially on the fœtal side of the placenta. Its existence was always ascertained by injections. The anastomosis exists sometimes between the veins, sometimes between both arteries and veins. Smellie and Levret had noticed this.

Hence the practical deduction to tie the cord of the first child on the maternal side where twins are suspected. The second twin before its expulsion may bleed through the umbilical cord of the first unless its placental end be tied. Spaeth gives a case where the second child was quite anæmic from this cause.

In general the *children were of unequal size.* Although twins are generally inferior in size to single children, both may attain the normal size of the latter; the larger of the two commonly does so.

Vital Relations.—Of Spaeth's 185 cases, both children were alive at birth in 176; in eight cases one was alive; in one both had been dead some time. "In four cases the dead child was much smaller and macerated. In three cases twisting of the cord was the cause of death. In one case fibrinous deposit in the placenta was the cause of death." The cause of death in this case specified by Spaeth is doubtful.

A curious phenomenon is sometimes observed. The two ova of a twin-pregnancy, or the two halves of a twin-ovum, present a high degree of *independence in their development.* Cases of one ovum remaining sound, and of the other being converted into a vesicular mole, and of one embryo being normal, the other malformed, are noted. Spaeth noticed in a case of united placentæ with two chorions, one of them studded with calcareous concretions, the other not. In another case fibrinous deposits have been found in one placenta and not in the other; in this case both twins were living. But the most singular cases are those in which one fœtus has died whilst the development of the other has gone on, although both were enclosed in a

[1] Scanzoni's Beiträge, 1868. [2] Edinburgh Med. Journal, 1858.

common chorion, and well-marked vascular anastomosis has been visible on the fœtal surface of the united placentæ, and the vessels of the dead embryo have not become impervious by twisting of the cord.

Tarnier relates a case in which one fœtus was acephalous, the other well-formed and living. Claudius[1] has made some very interesting observations upon this subject. All the capillary system of the placenta, he says, belongs to the well-formed fœtus. The umbilical vessels of the monster are composed of a venous branch and an arterial branch, which run respectively into the umbilical vein and one of the umbilical arteries of the other twin. Förster, admitting this disposition, applies it to explain the mechanism of the circulation in acardiac monsters. "Under the influences of the contractions of the heart of the twin, one part of the blood of the umbilical artery of the well-formed fœtus penetrates the body of the acephalous through its umbilical artery, and is distributed to the different parts of the body; it is then taken up by the capillary venous system, is collected in the veins, and by the intervention of the umbilical vein runs into that of the well-formed fœtus, to be distributed a second time in the body of this last. It results that the acephalous receives always a blood which has served for the nutrition of its twin, and which must have passed through the placenta for oxidation. This may explain the incomplete development of the body and the special preponderance of cellular tissue, as well as the œdema seen in many acephalous monsters."

Guillemot thought that the atrophy of one fœtus in the presence of a fellow that preserved its vitality was due to compression. Cruveilhier, as we have seen, thought it due to disease or detachment of the placenta. Caseaux and Tarnier think it due in most cases to disease of the embryo, of its membranes or placenta. Our own opinon is strongly in favor of the theory of compression. The dead fœtus is found so squeezed that it is called "foliaceous." When describing the diseases of the placenta, it will be seen to follow from the researches of Robert Barnes on fatty degeneration of the placenta, that the particular condition of the placenta found in these cases is really a *post-mortem* adipocerous-like metamorphosis.

We have seen that of twins one may be normal, the other deformed. Both may concur to produce a double monster. They may be fused together by the head, *cephalopagi*; by the trunk, *xiphopagi*; or by the pelvis, *ischiopagi* (G. St. Hilaire). These are almost certainly examples of division of one ovum.

Signs and Diagnosis of Twin-gestation.—The *general signs* due to compression of the abdominal vessels and encroachment upon the thorax, are too uncertain to warrant confidence.

We must appeal to the *local signs brought out by abdominal exploration.* The woman lying on her back or standing, a front view reveals *greater prominence of the abdomen*; the shape is less regular; we sometimes recognize two prominent points at the *fundus* with a depression more or less central between; generally also, especially if the two heads are seated in the fundus, the uterus and abdomen are broader across.

The touch or palpation offers the best evidence. Pinard describes a permanent tension of the uterine wall, comparable to the sensation imparted by a tightly filled cyst. Then the heads may be made out; they offer each a round, hard, mobile mass, giving cephalic ballottement. Pinard gives the following method: "One fœtal pole, the lower, is found in the pelvis or at the [illegible] of one of the iliac [illegible]. The continuous and resisting plane is sought for and found. So far the sensations are similar to those of single gestation;

[1] Die Entwickelung der Acardiacen. Magdeburg, 18[illegible].

but on depressing the abdominal wall on the side opposite to the resisting plane, instead of recognizing the small parts we find another, large or else a resisting plane. Then we must carefully explore both iliac fossæ and the upper segment of the uterus. Most frequently two large extremities are found either below or above. But whilst in some cases we may quickly detect the existence of four fœtal poles, two above, two below, it is sometimes only possible to make out three; the fourth deeply situated, is hidden behind one placed in front. It is generally easy to recognize two resisting planes, and the presence of small parts in several regions of the uterus. Thus proceeding gently, so as not to displace the fœtus, the presence of two big extremities, corresponding to the upper or lower region of the abdomen, puts us directly on the road to a diagnosis."

Vaginal touch will sometimes enable us to make out a head in the pelvis; whilst abdominal touch may have demonstrated the presence of another head at the fundus of the uterus, or in an iliac fossa. Ballottement is difficult in presence of twins, unless there be great excess of liquor amnii.

During labor touch may distinguish two successive bags of membranes.

Auscultation may render conclusive evidence. We seek for two *maxima* of intensity of fœtal sounds; and we may also distinguish *two rates of pulsations.*

Course and Terminations.—Twin-gestations frequently end before term, both being alive. Since one fœtus may die prematurely, it may excite the uterus as a foreign body and provoke the uterus to empty itself; but not seldom the developmental stimulus kept up by the living fœtus may overcome the influence of the dead fœtus, and gestation may be prolonged to the normal date.

The disposition of the fœtuses in twin and other multiple gestations in the uterine cavity is so essentially a clinical question that the consideration of it will be more convenient under the head of "Dystocia."

It is enough to note, in this place, that the disposition is governed by the law of accommodation. In the cases of twins the fœtuses may be placed: 1. Side by side, the most frequent arrangement. 2. One above the other. 3. One in front of the other. In order to pack most compactly, it commonly happens that one fœtus will present with the head downwards, its fellow with the breech, so that the head of each is in relation with the other's breech. Sometimes, however, both present head lowermost; in this case the head of one is at a higher level than the head of its fellow.

Triple Gestation.—Puech has made a careful analysis of cases. He calculated that the proportion was 1 in 4054 for Russia; 1 in 4995 for Ireland; 1 in 5442 for Norway; 1 in 6824 for a large part of Germany; and 1 in 8256 for France.

Anatomical Arrangement.—In 8 cases there were three placentas; in 15 cases, two placentas; in 27 cases, one placenta.

1. With three separate placentas, there are three distinct fruit-sacs, each having a chorion, an amnion, and each containing a fœtus. Sometimes, as in a case which came under Robert Barnes, the three placentas are quite separate, being cast one after the other. More often they cohere at their margins; but the circulations remain distinct. Specimens may be seen in most museums.

2. *With Two Placentas Distinct.*—One sac is complete for one of the fœtuses, and this sac corresponds to the smaller placenta. To the other placenta, which is about twice as large, the corresponding membranes may present one sac for the two fœtuses, or there may be two sacs with chorion and amnion dividing them, each with its fœtus; or there may be two sacs with intervening amnion only.

3. *With a Single Placenta.*—(1) There may be no line of demarcation. In this case there is one sac enclosing the three fœtuses. Or (2) there may be one line of demarcation. In this case the arrangement is similar to that in which there are two separate placentas. Or (3) there may be two lines of demarcation, and three distinct placental districts; then each fœtus has its own sac.

THE SEXES.—Veit found the same sex 768 times, different sexes 921 times, thus distributed: 3 boys, 409 times; 3 girls, 359 times; 2 boys to 1 girl, 501 times; and 2 girls to 1 boy, 420 times. So that the general law that more boys than girls are born holds good here.

THE DIAGNOSIS.—One sign has been noted: the great size of the abdomen towards the fifth month. By palpation Pinard made out three fœtal heads. Auscultation may distinguish three hearts or points of maximum intensity. Dunal[1] thus made out a triple gestation. But most frequently no diagnosis has been made until after the birth of one or two of the fœtuses. The successive presentation of a new bag of membranes and ballottement then point to the state of things.

THE COURSE AND TERMINATIONS.—Triple gestations rarely reach maturity; most commonly labor sets in about or before the seventh or eighth month. Abortion is more common in primigravidæ. As in twins, one of the fœtuses may perish; then it may either be expelled in the course of the gestation, or it may be preserved *in utero* until the other living fœtuses are born. In Robert Barnes's case, referred to above, the uterus ruptured spontaneously.

It is not rare to observe all three children to be born alive viable, and reared.

Quadruple Gestation.—The placentas may be distinct or united; there may be one, two, three, four fruit-sacs. As to the *sexes*, there were 4 boys, 7 times; 4 girls, 6 times; 2 girls and 2 boys, 9 times; 3 boys, 1 girl, 8 times; 3 girls, 1 boy, 6 times. The aggregates are the same for each sex.

DIAGNOSIS.—One is hardly likely to be called upon to make one. The difficulty increases with the complexity.

The termination is usually premature. We do not know of survivals. But the elder Dr. Rigby's wife brought forth four children born alive, who were named Primus, Secundus, Tertius, et Quartus. The same lady brought forth, we believe, twins and triplets.

Quintuple Gestation.—Galopin[2] relates the following case: A woman in her seventh pregnancy brought forth five children at five months and a half. All were living at birth, but died in a few minutes. All were boys. There were two placentas adherent by a small part of their circumference; three cords were inserted in one placenta, two in the other.

[1] Considérations pratiques sur les grossesses triples, 1860.
[2] Journal de Bruxelles, 1867.

CHAPTER VIII.

THE SIGNS AND DIAGNOSIS OF GESTATION—PATHOLOGICAL STATES WHICH SIMULATE GESTATION—THE DURATION OF GESTATION—CARE OF GRAVIDA.

The Clinical Discussion of the Signs and Diagnosis of Pregnancy.

THE preceding study of the process of gestation in its successive stages will supply the groundwork and many of the details out of which the diagnosis of pregnancy may be established. But for clinical purposes a special line of study *ad hoc* is necessary. This special line will also serve to fill in several points in the history of gestation hitherto passed over lightly in order to avoid repetition. We will, therefore, set out first the problems which have to be solved in practice; and then by analysis and synthesis examine the value of the several signs or phenomena of pregnancy individually and collectively.

The question: *Is a woman pregnant?* may present itself under various circumstances. And we may usefully dispose at the onset of certain moral, psychical, and emotional complications which force themselves into almost every case, often embarrassing our judgment.

We may divide the women who become the subjects of inquiry into three classes: 1. Those women, mostly married, who have no motive for misleading and no wish to mislead the physician, but in whom the existence of pregnancy is doubtful.

2. Women, mostly married, who wish to persuade themselves and to persuade the physician that they are pregnant. This class includes those cases of women, sometimes single, who seek to found a claim upon other persons. It includes the cases of women who at the climacteric misinterpret certain subjective phenomena, and believe themselves pregnant; and other cases, climacteric or not, in which the subjects are under the influence of insane delusions.

3. Women, single or married, who fear they may be pregnant and who would persuade you they are not.

The question of pregnancy is sometimes complicated with other conditions. For example: not only may ovarian tumors, fibroids of the uterus, ascites, ectopic gestation, and other conditions simulate uterine gestation, but any one of them may coexist with uterine pregnancy. These complications present the greatest difficulty. One of the complicating conditions may be detected, the other overlooked.

The simple issue, pregnant or not pregnant, then, is surrounded and obscured by all the fallacies of history and of innocent or wilful deceit. To guard against being misled by these sources of error we must draw a rigid line between subjective and objective phenomena. Without altogether disregarding the purely subjective signs, it may be stated broadly that they should never be accepted as sufficient proof of pregnancy. The subjective signs rest almost absolutely within the consciousness of the woman. To accept them from her, or even to be influenced by them, is to surrender the function of the physician. The wise physician must suppress that kind of reflex or emotional reasoning which consists in hasty responses to the impressions conveyed by the mental or emotional expressions of the patient. His

duty is to solve a medical problem by the strict processes of medical science. That is, he must rely mainly, if not absolutely, upon the objective signs.

Gooch expressed this idea grossly but tersely, saying, "In these matters we must not believe a woman's words, but her belly."

Basing upon this principle, we shall see that it is not less dangerous than ungenerous to seek to extort a confession of immorality or error from a woman suspected to be pregnant; and still less shall we be justified in taxing her with her misfortune in the presence of others.

We must not help out what should be a purely scientific objective diagnosis by applying the torture of moral inquisition. When we have come to a positive conclusion, the woman may be told gently but clearly that she is pregnant; we may advise her that she must take measures accordingly. She may deny the possibility of this condition. We may reflect that she is not bound to criminate herself; and we may be sure that, howsoever eagerly she may outwardly repel the unwelcome decision, she will inwardly accept it. Above all, we must never forget that we are physicians; and that we have no right to step outside our proper domain by assuming the functions of the law.

It is convenient to *divide gestation into three stages* for the purposes of diagnostic description. These may be defined as follows: *first stage, ending with the fourth month;* the *second, ending with the sixth or seventh month;* and *the third, ending with the full term.* The first stage presents the most difficulties. During the second and third stages, whilst the signs of the first persist and become even more accentuated, new signs, some of them of conclusive value, are developed. This division is made purely to facilitate description. The stages cannot be rigidly defined; they merge by imperceptible gradations.

A few lines, then, will suffice to enumerate the *subjective signs:* 1. Peculiar sensation at the time of coition interpreted as evidence of conception. 2. The arrest of the catamenia. 3. Certain sensations of pelvic distress, perhaps frequent micturition. 4. Disturbance of the digestive system, of which the prominent mark is *vomiting*, the "morning sickness." 5. Sensations of swelling, etc., and tension in the breasts. 6. In advanced gestation many women feel the movements of the child, or movements of the uterus.

Appreciation of the Subjective Signs.—These signs do not carry positive evidence either individually or in the aggregate. Each is open to fallacies. Each and all constantly deceive. The *first* is vitiated by two facts. In the first place, the peculiar sensation is not a necessary phenomenon. Many women conceive without noticing anything of the kind; they may be even altogether unconscious of impregnation having taken place. In the second place, many women—the wish or the dread being mother to the thought—have fancied or declared they had experienced the sensation who had not conceived at all. The *second sign* is notoriously untrustworthy. Menstruation, in the first place, may have been absent some months before conception. This happens not seldom to suckling women. Some have thus conceived, bringing forth and suckling several children in succession without menstruating. In the second place, the cases are not uncommon in which menstruation, or at least a simulating periodical discharge of blood, is observed during several months of gestation. The *third sign*, the pelvic distress, sense of weight, heat, frequent micturition, may be produced by enlargement of the uterus from other causes. The *fourth sign*, the morning sickness, is perhaps the most valuable; but it may be absent altogether; it may be due to other causes, amongst them to uterine distention from other causes than pregnancy; and it may be procured designedly or falsely affirmed to exist. The *fifth sign*, the sensations in the breast, have no absolute value, for reasons similar to those which vitiate the fourth sign. It only merits

attention when it is confirmed by objective signs. The *sixth sign*, subjectively considered, is sometimes of value; but we cannot always place implicit confidence either in the correctness of the woman's interpretation of her sensations, or in the truthfulness of her statements. We have even known more than one instance of a pluriparous married woman, apparently free from all motive for dissimulation, declaring herself quite unconscious of being pregnant, until overtaken by labor at term. We conclude, then, that these subjective signs, separately analyzed, justify no decision, positive or negative. Nor do they acquire value considered synthetically. In this respect they differ from certain objective signs which, taken together, almost compel an affirmative judgment, illustrating the old Roman law maxim: "Multa collecta probant, quæ singulatim non probant."

One remark it is important to make. Whatever the value of the subjective signs, it is chiefly limited to the first two or three months of pregnancy, when the more certain objective signs are not yet developed. For this evidence we should wait. Justice to the patient, prudent regard for his own reputation, will dictate to the physician reticence in the absence of conclusive evidence. Adjourn the case for a month, and so on from month to month, until Time, the great solver of mysteries, shall develop exact, positive signs, or enable us to decide in the negative.

The Objective Signs of the First Stage, or Trimestrium of Gestation.

Referring to our sketch of the natural history of gestation, we may distribute the objective signs of early gestation as follows: (A) Alterations in the play of the nervous system, including some subjective phenomena. (B) Alterations in the vascular system. (C) Alterations in the glandular system, including the breasts. (D) Alterations in the skin and mucous membranes, including pigmentation. (E) Alterations in the uterus and vagina.

(A) Alterations in the nervous system may be passed by, referring back to the description under the "Natural History of Gestation." It is enough to state here that, although some of the nervous phenomena have a distinct objective value when witnessed by the skilled observer, they only acquire real diagnostic value when studied in connection with the more absolute objective signs to be described in succeeding paragraphs.

(B) The alterations in the vascular system possess great objective value. Referring back to the chapter on the "Natural History of Gestation" for the main facts ascertained as to the chemical and microscopic characters of the blood, we have here to consider more especially the changes in the dynamics of the circulation and in the structure of the heart and blood-vessels. The physiological hypertrophy of the heart can hardly be estimated for diagnostic purposes by percussion or other means; but its action upon the arteries and the attendant changes produced in the capillaries and veins are open to precise observation. There are three leading facts: first, the predominant vascular activity in the region of the pelvis, determined by the developmental nisus; secondly, the correlated increase of arterial tension; thirdly, the general fulness and distention of the capillaries and veins. We get distinct objective evidence of all these conditions. First, examining the vulva, vagina, and vaginal portion by the eye, using the speculum, the *mucous membrane is seen tumid, deepened in color, from dark to dusky-red, even of violet hue*, and in some cases almost black. Sometimes the smaller veins are so greatly enlarged that they form prominent tortuous elevations at the lower part of the vagina and on the labia vulvæ. So marked may this venectasis be that large masses are found, projecting like a tumor, out-

side the vulva. Thus we have known such a mass described by the patient as the presenting foot of the child. This is sometimes called *Kluge's test.* McClintock says—and we confirm his statement—that the color fades if the embryo dies.

But the capillary and venous fulness is not limited to the genital organs. The anus and the rectum, as far as it can be seen, are intensely hyperæmic; piles may be produced, and, where already existing, are greatly enlarged and of darker color. More than this: although the centre of greatest hyperæmia is in the pelvic vascular region, a similar condition is seen elsewhere. The *thighs and legs commonly show the superficial veins red and branching*, and *varicose knots* are often seen on the legs and at the crural arch. So significant are these superficial venous arborizations, that we are accustomed to regard them as the strongest presumptive evidence of pregnancy. Whenever we see them in a distinct form on the thighs of young women there is ground enough to make further inquiry, and it is very rare, indeed, not to find corroborative evidence in the state of the mucous membrane of the vagina already described. Singly, these signs are of great value; taken together, they challenge almost implicit confidence. The arborescent state of the superficial veins of the legs may, indeed, exist under other conditions than that of pregnancy, and the purple coloration of the vagina may be stimulated by the hyperæmia dependent upon impediment to the portal veins, as in women at or approaching the climacteric. But the concurrence of the two conditions will almost invariably be found to be due to pregnancy. We are, however, seldom reduced to the position of having to decide upon these alone. The active hyperæmia of the vagina is attended by a *white cream-like secretion hanging about the vaginal portion* and the fundus of the vagina, which is all but characteristic when seen upon the described purple mucous membrane. This secretion consists almost entirely of vaginal pavement-epithelium-scales in a state of granular degeneration, held together by a little plasm. This *epithelium-shedding* is the natural result of the intense vascularity of the mucous membrane. The addition of this sign, again, lends cumulative weight. If we discover, as we shall rarely fail to do where these are present, *increased weight and bulk of the uterus*, we then arrive at a compact and consistent body of evidence pointing almost irresistibly to pregnancy. The *veins of the breasts at the same time exhibit similar prominence* and development. But the value of the breast appearances and the conditions of the uterus will be discussed further on.

We may now consider the *correlated increase of tension of the arterial system.* The sphygmograph places this in the clearest light. Fancourt Barnes has studied this subject with care. In the diagnosis of early pregnancy the aid of the sphygmograph should be called in.

(C) Alterations in the Glandular System, Including the Breasts.—The changes produced by pregnancy in the breasts naturally attract more attention than those of other glands. They form a second centre of developmental activity. The changes in them proceed, *pari passu*, with those in the uterus.

In the appreciation of the worth of the signs given by the breasts we must bear in mind—first, that the appearances of fulness, distention, superficial venous development, prominence of the glandules of the areola, darkening of the areola, and secretion of milk, may all be due to the transient influences of a menstrual period; they, or one or more of them, may be associated with ovarian or uterine disease; in some cases of pregnancy these signs are so faint, even if recognized at all, that they carry no weight. Again, in some cases of women who have borne children, the breast-changes persist in so marked a manner that it is difficult to decide whether or not

the changes observed are due to an antecedent gestation. Another caution is necessary: Whatever confidence skill in observation of the breasts may give, evidence offered by them should not be accepted as conclusive. If pregnancy exist we shall surely find other evidence of it to confirm a diagnosis, which otherwise can only be presumptive. Some physicians, who have devoted particular study to the subject, have acquired great confidence in the signs the breasts present. An anecdote is reported of William Hunter, that on seeing the body of a young woman in the dissecting-room, on looking at the breasts, he pronounced her to be pregnant. She was found to have an intact hymen. Hunter persisted notwithstanding, and on opening the abdomen his diagnosis was verified.

Montgomery[1] says: "When conception has taken place and the menses have been suppressed for one or two periods, the woman generally becomes sensible of an alteration in the state of the breasts, in which she feels an unceasing sensation of throbbing, or of stretching fulness, accompanied by soreness and tingling pains felt about the centre of them, and in the nipple. The breasts grow larger and firmer; a circle around the nipple becomes altered in color and structure, constituting the areola; and as gestation advances milk is secreted. But there is considerable variety in the period of gestation at which these changes may occur." In some they are developed early, in others the changes are hardly perceptible until gestation is far advanced; and in some they are so little developed as to present nothing characteristic.

It is difficult, if not impossible, therefore, to give a definite statement of the breast-changes to serve for diagnostic purposes according to the successive stages of pregnancy. Generally they are not very well marked during the first trimestrium, they become more conspicuous during the second trimestrium, and increase in value towards the end of the last trimestrium. But at this time they are more or less superfluous, since absolute signs will have been developed in the uterus. Milk oozing from the breasts will stiffen the linen of the dress with which it comes in contact. In this way suspicion of gestation has often been aroused.

The mammary signs of pregnancy are thus admirably summed up by Rœderer: "Menstruorum suppressionem mammarum tumor insequitur; quocirca, mammæ crescunt, replentur, dolent interdum, indurescunt; venæ earum cæruleo colore conspicuæ redduntur, crassescit papilla, inflata videtur, color ejusdem fit obscurior, simili colore distinguitur discus ambiens, qui in latitudinem majorem expanditur, parvisque eminentiis, quasi totidem papillulis, tegitur."

To Rœderer's description the following conditions may be added as deserving special notice: A soft and moist state of the skin of the areola, which appears a little raised above the surrounding skin, and in a state of turgescence, giving the idea that if touched by the point of the finger it would be found emphysematous; 2, the little glandular follicles or tubercles of Morgagni are bedewed with a secretion sufficient to damp and color the woman's inner dress; 3, later on the dark pigmented areola presents round spots lighter than the prevailing tint, resembling what might be imagined to be the effect of letting drops of water fall upon a black pigment and partly washing it out; 4, blue veins, slightly prominent, are seen coursing over the breast and the areola.

These features do not all come into prominence at once or at an exactly defined time. They also vary in intensity in different individuals, being especially marked in brunettes. But the development of the superficial

[1] Signs and Symptoms of Pregnancy, 2d ed., 1856.

veins is often marked in blondes. The combination of these conditions affords very strong evidence of gestation. It is rare to find a case where a similar combination is produced under any other circumstances.

The breasts increase in volume. During the first pregnancy, says C. Langer,[1] new glandular vesicles are formed; thus in the breast, as in the uterus, new elements appear. In the succeeding pregnancy the breasts enlarge again, but there is no development of new vesicles.

Montgomery says the color of the areola depends on the deposition of an actual pigment between the cuticle and subjacent skin. Dubois says he saw an instance in which the cuticle peeled off the disk of the areola, carrying with it the pigment in small scales.

(D) Alterations in the Skin and Mucous Membranes.—Some of these alterations dependent upon changes in the vascularization and glandular action have been already described. A most remarkable change is that resulting from pigmentation. This has been described in the chapter on the "Natural History of Gestation." It only remains in this clinical connection to refer to the fallacies which attend pigmentation when regarded as a test of pregnancy. It may be stated in the first place that the pigment-phenomena are chiefly of value in first pregnancies. The pigment deposits found in the first pregnancy are apt to persist more or less, to be intensified probably in subsequent pregnancies, but also to be seen in the non-pregnant intervals. Secondly, pigment changes in the breasts, on the abdomen, and elsewhere, as produced in pregnancy are occasionally simulated under conditions distinct from pregnancy, and especially in connection with uterine and ovarian diseases which may be attended by abdominal enlargements, and therefore suggestive of pregnancy.

Still the significance of the characteristic pigment changes should not be disregarded. Although never attaining *per se* to more than presumptive value, they do possess a certain weight as part of a body of cumulative evidence.

The skin changes will be further described with the signs of the third trimestrium.

(E) Alterations in the Uterus and Vagina.—The visible alterations in the vaginal portion and vagina have been already described and estimated. The alterations in the uterus proper are of the highest importance. They consist in changes of (1) size and weight, (2) of form, (3) of position or relation to other organs. These are all made out by touch.

(1) Immediately after fertilization the uterus swells, becoming turgid from the attraction of blood into its substance. The increase in size and weight soon becomes sensible to the touch. But before a month has elapsed the difference is hardly marked enough to justify more than conjecture. At the end of a month, however, the difference gives an objective sign of considerable value. In conducting the examination, the woman is placed first upon her back with the shoulders slightly raised, and the thighs a little flexed. The index finger is then passed into the vagina, and carried along the posterior wall until it strikes upon the vaginal portion of the uterus. We then determine several physical conditions. The *position* of the vaginal portion; this is in the sacral hollow. If a line be drawn subtending the arc formed by the sacrum from the projection of the promontory to the top of the coccyx, the os externum uteri will at the end of the first month point a little above the middle of the line. The vaginal portion gives a soft velvety sensation to the finger; the os itself may be more or less open; in primiparæ it may

[1] "Ueber den Bau und die Entwickelung der Milchdrüsen." Denkschriften der Wiener Akademie, 1851.

admit the tip of the finger, in pluriparæ much more; secondly, carrying the tip of the finger forwards along the anterior surface of the vaginal portion, tracing it to the body of the uterus, we feel through the anterior upper wall of the vagina the smooth rounded form of the uterine body, depressing this part of the vaginal wall, smoothing out to some extent its rugæ. This is due to the nutation of the uterus under the increase of weight which affects the body and fundus of the uterus. This nutation of the fundus tilts up the vaginal portion, and explains why the os is felt so high up underneath the promontory, and also the smoothing of the anterior wall of the vagina. Thus is formed an inclined plane upon which the uterus rests. By the

FIG. 88.

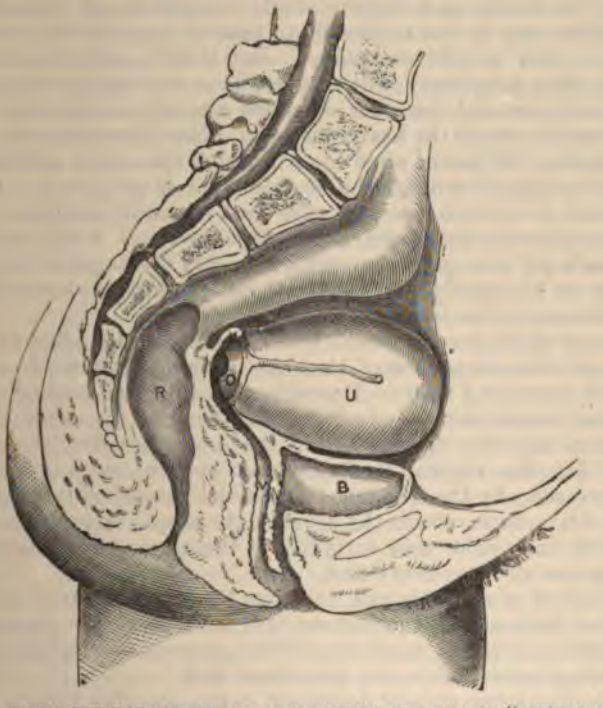


DIAGRAM SHOWING NUTATION OF UTERUS AT SECOND MONTH OF GESTATION AND "ANTERIOR VAGINAL ROOF-STRETCHING." (ROBERT BARNES.)

U. Uterus. O. Os uteri. R. Rectum. V. Vagina. B. Bladder.

ascending retreat of the vaginal portion the base of the bladder by its connection with the anterior wall of the cervix uteri is dragged up, and the urethra is sometimes drawn up a little behind the symphysis pubis. This condition and the pressure of the fundus uteri upon the bladder explain the frequent desire to micturate which harasses women in early pregnancy. In this up-tilting of the vaginal portion, the vagina is really deviated from its ordinary track. Its upper half is carried backwards. This condition, very characteristic, Robert Barnes has called "the *anterior vaginal roof-stretching*." The woman still in the dorsal position, the finger pressing upon the uterine body through the anterior vaginal wall finds that it is heavier and bigger than the healthy non-pregnant organ. This observation is repeated in another way: the finger is carried back to the os uteri; poising the uterus upon the

finger-tip, the weight can be closely estimated; keeping the finger in the same position the finger-tips of the other hand are pressed upon the abdomen just above the symphysis pubis; thus the fundus of the uterus may be felt, and the combined or alternate pressure of the finger on the os uteri and of the fingers outside gives very close estimate of the size and weight of the uterus.

The observation may now be extended and repeated by placing the woman on her left side with the knees drawn up. In this posture one can often get a better command of the uterus between the two hands. Should there be any difficulty in examining by the vagina, the finger may be passed up the rectum. The vaginal portion is thus easily felt.

Appreciation of the Signs Described.—Increased weight and size telling most upon the fundus and causing similar irritation and vaginal stretching and deviation may be due to fibrosis, to general hyperplasia, to intrauterine polypus, or other morbid conditions. But it will rarely happen that anything else than pregnancy will also produce the changes of color in the mucous membrane and the other objective alterations described. We have known a case in which the heart was weak, often intermittent in action, the circulation slow, the hands often blue, in which the vagina presented a deep-blue injection hardly distinguishable from that of pregnancy. Obstruction of the portal circulation also may give rise to a similar appearance. Thus the evidence, howsoever strong, is not absolute; and it will not be wise to commit one's self to a positive opinion either in the negative or affirmative. Take note as accurately as possible of the conditions observed, and store them for future comparison.

At the end of the second month all the signs just described are more pronounced, and the comparison of the state of things at the two epochs gives evidence of increasing value. Proceeding by the same method of examination, we find the nutation of the body, the rising of the os uteri, which now will be found near the upper third of the line subtending the coccygo-promontorial arc, the vaginal roof-stretching, the volume and weight of the uterus increased; by the bimanual touch the fundus of the uterus is more distinctly felt a little above the level of the upper edge of the symphysis pubis. The dark color and turgidity of the vagina are intensified. The evidence grows stronger every day.

At the end of the third month the signs have become even more distinct. The vaginal portion is still prominent, it is closer under the promontory; the fundus is still in nutation, and it may be felt more clearly under the bimanual touch, coming more close to the abdominal wall.

The objective signs as now developed taken together form a very strong body of evidence; and if we have had the opportunity of making observations at the end of each of the two preceding months, and thus are in a position to trace the gradual and regular increase of the uterus in size and weight, we then possess evidence that rises to the highest degree of probability. Still we have not attained to certainty, at least not to that certainty which would warrant us in delivering an unqualified affirmative opinion in a court of law.

This is to say, that the diagnosis of pregnancy during the first stage is still not absolute, although it may be clear enough to guide the conduct of the physician in advising his patient.

New evidence of increasing intrinsic value is gathering, and adding strength to the evidence developed during the first trimestrium.

Objective Signs of the Second Stage or Trimestrium.

This new evidence is brought out—1, by auscultation; 2, by abdominal palpation; 3, by repercussion or ballottement.

At the end of the third month, sometimes auscultation lends its aid. Before setting forth the applications of Mayor's grand discovery, it will be convenient to state simply what signs are detected by auscultation, in the order of their relative importance, disregarding the chronological order of their evolution.

These *auscultation-signs* are: 1, the sounds of the fœtal heart—Mayor's original discovery, 1818; 2, the uterine souffle—De Kergaradec's discovery, 1822; 3, feeling the movements of the fœtus by a metroscope applied by vagina—Nauche's discovery, 1829; 4, the pulsation of the umbilical cord, the funic souffle—Evory Kennedy's discovery, 1833.

If we take these phenomena in the order of clinical observation, the order most useful for our purpose, we first seek to detect the *uterine souffle*. This is rarely detected earlier than the thirteenth or fourteenth week. This sound has been variously interpreted. Some thought it simply due to anæmia, that it was in fact an anæmic souffle heard in the external iliac arteries. This theory has not been widely received.

The Placental Theory.—Hohl and others held it to be produced by the passage of blood from the uterine arteries into the placental sinuses; hence it has been called the placental souffle or bruit. That this theory cannot be absolutely true is proved—1, by the fact that the sound is often heard with equal distinctness in both inguinal regions in cases where observations during labor prove that the placenta was situated at the fundus uteri; 2, that the seat of the sound is shifting, now heard in one place, now in another; 3, that Bailly and Maggia show that the sound continues for several hours, even three days, after the expulsion of the placenta.

The iliac theory advocated by Bouillaud is that the sound is produced in the large arteries of the pelvis under compression from the gravid uterus. Whenever an arterial trunk is compressed, a *bruit de souffle* is produced; and then there is the quasi-chlorotic blood of gravity to favor the production of the sound. But the theory is untenable—1, because the sound has been heard in the second or third month—that is, before the uterus is big enough to compress the pelvic arteries; 2, because the sound should invariably be heard in the sides and lower part of the abdomen, which is not the case; 3, the sound is still heard when the subject is placed in the knee-elbow posture, so that the uterus falls away from the arterial trunks; 4, because the fact of persistent compression of the vessels even in advanced pregnancy is doubtful; 5, the *chlorotic* part of this *theory* is disproved by a clinical observation made by Robert Barnes. In a woman seen at St. Thomas's Hospital, the placental or uterine souffle was heard characteristic on one side, and the normal sound of the iliac artery was heard on the opposite side.

The Uterine Theory.—The theory that the sound is produced in the uterus was started by P. Dubois, and is adopted by Tarnier and Marey. The sound is sometimes quite superficial; even a thrill is sometimes perceived by the touch. This can only come from the uterine vessels. Dubois likened the sound to that which takes place when an arterial thrombus suddenly throws its blood into a vein. He held that the uterine walls were transformed during gestation into a kind of erectile tissue. But Jacquemier demonstrated that the large and free communications between arteries and veins admitted by Dubois do not exist. Corrigan and Depaul thought the *bruit de souffle* was due to a change in the calibre of the uterine arteries. At

the point where the arteries penetrate the uterus they divide and expand, so that the divisions have a greater calibre than the trunk from which they rise. Now whenever fluids run under these circumstances a friction sound is produced.

This theory will explain the occasional occurrence of the sound in the front of the uterus. But it appears that it is quite consistent also with the placental theory. The uterine arteries emerging from the inner wall of the uterus suddenly open into the placental vascular system. This is exactly the condition postulated by the theory now discussed. The placenta may be likened to a vascular tumor.

THE EPIGASTRIC THEORY.—Kiwisch,[1] Glénard,[2] of Lyons, and Hecker showed that the sound may be in the epigastric artery. Glénard said that by compressing this artery the sound was stopped. To this Tarnier objected that the compression used to stop the epigastric might compress the trunk of the uterine arteries. Thus Glénard abandoned the epigastric theory, and after new observations submitted that the seat of the sound was in an artery situated on the antero-lateral wall of the uterus, which he called the *puerperal artery*. This is to fall back upon the uterine theory.

We are disposed to conclude that there are two sources of the sound—1, in the vessels in the uterine walls; 2, in the utero-placental circulation. We do not think the placental theory can be absolutely rejected.

Its distinctive characters are: 1. A blowing, snoring, whistling, or rushing sound, resembling the sound heard in the neck of chlorotic girls; Depaul says it is very closely imitated when we pronounce the word "*vous*" softly. 2. Isochronism with the mother's pulse. It is a maternal sound. 3. It is inconstant in place, intensity, and other qualities. It may change seat; heard at one time in one spot, at another time it may be heard in a spot where it could not be heard before. Sometimes the sound is lost for a time, then reappears. Its *intensity* increases usually with the advance of gestation. It is modified, says Depaul, by all causes which diminish the calibre of the vessels of the uterus, by strong compression with the stethoscope, by certain active movements of the fœtus, and above all by uterine contractions.

HOW TO OBSERVE THE UTERINE OR UTERO-PLACENTAL SOUND.—Place the subject on her back, with the shoulders slightly raised; bare the abdomen from the pubes to the epigastrium, so as to command the entire area occupied by the uterus. Apply the stethoscope first immediately above the pubes in the median line, then on either side above Poupart's ligament, then carry it over the whole accessible surface of the uterus. To determine its isochronism with the maternal heart-beat, either first count the souffle sounds, watch in hand, and then count the radial pulsations and compare the number of beats obtained from each source, or compare the two simultaneously by concurrent observations of ear and finger.

The binaural stethoscope is especially useful in uterine auscultation, as its flexibility enables the observer to apply the cone to any part of the uterus without awkward stooping or changing his position.

Fallacies.—A sound, hardly if at all distinguishable from the uterine souffle of pregnancy, is heard, rarely indeed, in some cases of ovarian tumors and myomatous tumors of the uterus. In such cases other signs, negative or positive, will rarely be wanting to establish a diagnosis.

Sometimes where pregnancy is undoubtedly present the sound is not detected at all. It may be heard one day and not the next. If not heard,

[1] Klinische Vorträge, 1849. [2] Archives de Tocologie, 1876.

therefore, the observation must be repeated before pronouncing a decision against pregnancy or concluding that the child is dead.

Sounds Produced by the Active Movements of the Fœtus.—The fœtus executes certain movements. Listening, one hears the sound of shocks comparable to that produced when the finger-tip strikes a bit of cloth stretched out. These sounds, say Tarnier and Chantreuil, can be heard from the end of the third month. Then they are the effect of the displacement of the entire fœtus. At the end of gestation they are more localized towards the fundus of the uterus. Then they are produced by the movements of the limbs or of the head. The fœtus may even rotate on itself. Auscultation at this moment reveals a particular *rustling sound* (*"frôlement"*). In some rare cases there is heard a rhythmic sound of slow cadence, apparently produced by the shock of the limb against the uterine wall. These shocks are equal in intensity and occur at regular intervals.

At the third month the sounds due to the *active movements* constitute an excellent symptom of pregnancy not to be neglected, since at this time the heart-beats are commonly inaudible.

The Fœtal Shock.—The *"choc fœtal"* of Pajot is thus described: "Under the pressure of the stethoscope one perceives at the same time at the moment when the movement is produced a double sensation of *shock* and of *quick sound*, but of *extreme delicacy;* the ear struck at the same time in its general and special sensibility, receives at once a tactile and an auditory impression." This sign may be noted at the fourth month. It has, however, but a limited value, since taken alone it is open to fallacies, and when more certain signs are developed it is superfluous.

The Fœtal Heart-sounds.—The next sounds observed in clinical order are those produced by the movements of the fœtal heart. They resemble those of the adult heart in the mechanism of their production.

The character of these sounds is that they are double. They have been aptly compared to the ticking of a watch heard through a pillow. A more exact idea may be acquired by listening to the heart of a newly born child. There is a first sound, the stronger, then a brief silence, then a second sound, less intense, then a longer silence. The first sound is due to the ventricular systole.

When is the Sound First Heard?—Depaul and Tarnier say that in some instances by applying the stethoscope firmly on the fundus of the uterus above the pubes, and repeating the observations, it may be heard about the middle of the fourth month and even as early as the end of the third month. But most authors agree that it is rarely detected earlier than at four months and a half.

The *intensity* of the sounds varies according to the force of the organ giving them; this varies in individuals, and increases with the advance of gestation. It is affected by circumstances favorable or the reverse to its transmission. Thus the thickness of the abdominal walls and those of the uterus, the quantity of liquor amnii, and the position of the fœtus in the uterus, may modify the sounds. During labor, they become louder when the membranes are ruptured.

Generally the sounds are heard over an area four inches in diameter and sometimes over the whole anterior surface of the uterus. But there is one point—*the point of greatest intensity*—where the sounds are clearest. Its seat will vary with the position of the fœtus. Where two maximum intensities are observed we have evidence of twins.

The *frequency* of the fœtal heart-beat is greater than that of the adult or of the mother. It is stated to range from 120 to 160. Robert Barnes has observed cases in which it did not exceed 100. But it can only be by the

rarest coincidence that it will be isochronous with that of the mother. The frequency may vary under conditions arising in the fœtus, such as spontaneous movements or displacements caused by the observer. There is no relation between the rate of pulsation of the fœtal and maternal hearts. But Winckel[1] says, "When the mother's temperature is raised the fœtal heart beats more quickly;" and that the child is endangered in proportion to the increase of its mother's temperature.

The *slowing* of the fœtal heart-beats is rarely observed during pregnancy except when the life of the fœtus is threatened. The slowing is, however, constant under the energetic uterine contractions of labor. This is observed: at the commencement of the contraction an acceleration of very brief duration occurs, then as the contraction goes on a variable slowing, but never in normal conditions falling below 100. As soon as the contraction yields the beats increase. When the slowing is permanent the fœtus is in danger. Hardy and McClintock found that under the administration of ergot the strength, number, and regularity of the pulsations diminished, and were even extinguished. Robert Barnes made[2] precisely similar observations on the fœtal pulse as affected by uterine contractions and by aërial respiration in cases of children permaturely born before division of the cord. In cases where no respiration was made the heart slowed and was for the time stopped under the uterine contractions, recovering its former rate as the uterus relaxed. Exactly similar conditions were observed under the influence of respirations. These took place at long intervals, so that the observations were easy. When the child breathed the heart-beat rose; when the respiration ended the heart-beat fell, and revived again at the next respiration. This experiment is easily made by feeling the umbilical cord at the navel. It illustrates the analogy between placental and aërial respiration, showing that one is the equivalent of the other in influence upon the heart.

Is the Rate of Heart-beat Different in the Two Sexes?—Frankenhäuser (1859) affirmed that the female heart beat more quickly than that of the male, and that a beat above 144 in the minute indicates a girl, and a beat below that rate a boy.

Others have tested these conclusions, some supporting, some contradicting. Our own experience agrees with Budin and Chaignot's observations. They declare that there is no constant relation whatever. Quick and slow rates are found in fœtuses of either sex; and one may in the same subject find the rate vary fifteen to twenty beats within a brief period.

What does the observation of the fœtal heart teach?

1. When heard it teaches that there is a child; and that it is alive.
2. It gives information as to the vigor of the child.
3. It indicates the presentation and position of the child *in utero*.

To arrive at a diagnosis of the presentation we search for the spot of *maximum intensity*, since the heart is situated at the level of this maximum. In presentations of the head, gestation advanced, this maximum is found below a line drawn horizontally across the umbilicus, or by the middle of the height of the uterus measured from the pubes to the fundus of the organ; whilst, in presentations of the breech, this maximum is heard at the level of, or above this line. Depaul thus explains these facts: The heart is nearer to the cephalic than to the pelvic extremity, so that of necessity its maximum intensity is heard lower when the head presents than when the breech presents. But Ribemont-Dessaignes proves, by sections of the fœtus, that the heart is quite as near one extremity as the other. The true explanation is, that towards the end of gestation the head sinks a little into the pelvis,

[1] Die Pathologie der Geburt. [2] London Hospital Reports.

especially in primiparæ, and the heart thus following the descent is heard below the umbilical level. In breech-presentations the breech keeps above the brim, and thus the heart, kept at a higher level, is heard above the umbilicus.

But if from narrowing of the pelvic brim, placenta prævia, or excessive size of the head, the head cannot enter the pelvis, the maximum intensity may be heard as high as in the case of a breech-presentation.

Transverse presentations cannot be with any certainty diagnosed by auscultation.

CAN THE POSITIONS OF THE FŒTUS BE DIAGNOSED BY AUSCULTATION?—Tarnier, after analyzing the views of Depaul and Ribemont-Dessaignes, concludes generally in favor of the latter observer. In the left anterior occipito-iliac (or first) position, the maximum is heard to the left of the median line; but it is on a line running from the navel to the left antero-superior iliac spine, and not to the left ileo-pectineal eminence. It is not the vertebral column of the fœtus, but the left side which corresponds to this ileo-umbilical line.

In the left posterior occipito-iliac (or fourth) position the maximum is heard a little to the left or behind the ileo-umbilical line; sometimes it even reaches this line, for in this position it is the right side of the fœtus which is in relation with the antero-lateral wall of the uterus and abdomen, which best transmits the sounds of the heart. It is therefore difficult to distinguish the left anterior position from the left posterior by auscultation.

In the right anterior occipito-iliac (or second position) Ribemont-Dessaignes found the maximum on the median line. This line corresponds with the left side of the fœtus which directly transmits the heart-sounds to the uterine and abdominal walls. In the right posterior occipito-iliac (or third position) the maximum is heard on a line running from the navel, either to the right ileo-pectineal eminence, or to the right antero-superior iliac spine. The left side of the fœtus corresponds in this position to the antero-lateral wall of the uterus and of the abdomen.

But palpation gives more trustworthy indications of the positions.

THE FŒTAL SOUFFLE.—This is a sound isochronous with the heart-beat. It is simple or double. At times it has its seat at the level of the heart. Then it is called *cardiac* or *intracardiac*. At times it is heard in the vessels of the cord. Then it is called the *umbilical* or *funicular souffle*. Cardiac souffle may be due to insufficiency of the tricuspid and mitral valves, and to vegetations on them (endocarditis).

The *umbilical souffle*, discovered by Kennedy, who, with Naegelé, Depaul, and others, thought the sound indicated that the cord was twisted round the child's neck. When heard it proves that the child is alive.

HOW TO OBSERVE THE FŒTAL HEART-SOUNDS.—Generally the plan laid down for observing the uterine souffle may be adopted. We should seek for the heart-sounds more especially in the region indicated in the preceding description—that is, nearer the umbilicus or near the centre of the uterine globe. Having detected the sound we then, by shifting the stethoscope and following the sound in all directions, track out the point of maximum intensity. We then count the pulsations and compare them with those of the mother's radial. If the rates differ, the diagnosis of a live child is absolute.

Fallacies.—These are really very few. When the maternal circulation is excited its frequency may simulate fœtal pulsations, if heard through the abdominal walls. Error is avoided by noting that these pulsations are isochronous with the radial beats. Where doubt remains we must invoke the light of other signs, as palpation.

Palpation.—In the second stage abdominal palpation acquires importance, increasing with the advance of the process. At the beginning of the fourth month palpation may detect the fundus of the enlarged uterus pointing above the pubes; and this is especially useful if combined with internal touch upon the vaginal portion, as described for the first trimestrium.

But gradually, as the uterus rises higher and higher, it is more easily felt with increasing distinctness. Not only is the fundus felt, but a great part of the contour of the uterus may be traced between the two hands, applied above and on either side. And its position and size may be delineated also by percussion; one mode of exploration aiding and correcting the other.

Palpation and percussion will enable us to follow the uterus in its gradual development. Thus we may estimate the stage of pregnancy arrived at.

At the end of the	3d month	the fundus uteri rises just above the symphysis pubis.
" "	4th "	" half way between pubes and navel.
" "	5th "	" within a finger's breadth of the navel.
" "	6th "	" a finger's breadth above the navel.
" "	7th "	" three or four fingers' breadth above the navel.
Between 7th and	8th "	" the fundus inclines to the right.
In first half of the	9th "	" in the epigastric region and under the edge of the right false ribs.
In second half of	9th "	" the fundus drops.

RATE OF INCREASE IN SIZE OF THE GRAVID UTERUS ACCORDING TO MONTHS.
(After A. FARRE.)

	Length.	Breadth.
End of 3 months	10 to 12½ centimetres (4 to 5 inches).	10 centimetres (4 inches).
" 4 "	13 to 15 centimetres (5 to 6 inches)	12½ centimetres (5 inches).
" 5 "	15 to 17½ centimetres (6 to 7 inches).	13½ centimetres (6 inches).
" 6 "	20 to 22½ centimetres (8 to 9 inches).	16 centimetres (6½ inches).
" 7 "	25 centimetres (10 inches).	18 centimetres (7½ inches).
" 8 "	27½ centimetres (11 inches).	20 centimetres (8 inches).
" 9 "	30 centimetres (12 inches).	22½ centimetres (9 inches).

The above statement is more especially exact as regards primiparæ. In pluriparæ, whose abdominal walls are more relaxed, the uterus ill-supported may fall forwards, more or less overhanging the pubes; and the uterine fundus does not drop by its lower segment sinking into the pelvis.

ABDOMINAL PALPATION APPLIED TO THE DIAGNOSIS OF PREGNANCY.—This has been gradually brought to perfection under the successive labors of Rœderer, Wigand, Joerg, Schmidt, Hohl, Velpeau, C. Devilliers and Chailly, Hubert, Jacquemier, Matteï, Esterlé, G. Murray, Scanzoni, Tarnier, Schröder, J. R. Chadwick, Spiegelberg. The history of the method, beginning almost with this century, is carefully drawn by Pinard.[1]

INFORMATION OBTAINABLE BY ABDOMINAL PALPATION.—By this manœuvre we determine the existence or absence of a tumor in the abdomen or emerging from the pelvic cavity. If a tumor be felt, we determine its nature. If determined or presumed to be the uterus, we determine its size, shape, direction, relations, and consistency. If the uterus be developed to

[1] Traité du Palper Abdominal, Paris, 1878.

four months' gestation or more, we may by palpation discover the attitude of the fœtus and thence its presentation and position; it is especially useful in making out twin-pregnancy; it also enables us to estimate the proportion of liquor amnii.

How to Practise Abdominal Palpation. 1. *The Disposition of the Patient.*—She is so far undressed that the chest and abdomen are free; she is placed on her back, the head and shoulders resting upon a pillow, the arms falling on either side; the bladder and rectum must be emptied.

2. *The Conduct of the Examiner.*—He warms his hands to the temperature of the patient's body, lest by cold he cause the muscles of the abdomen to contract and harden. A hand is then applied, at first very gently, on either side of the abdomen; then pressure is gradually increased, so as not to awaken emotional, volitional, or reflex resistance. When the muscles resist, the hand is kept quite still, neither increasing nor lessening the pressure, and presently the muscles will relax. The pressures are repeated several times in succession, progressively increasing their intensity. This manœuvre is best done during expiration; and it is useful to get the patient to breathe in and breathe out deeply, keeping the mouth open as if she had been running hard. In this way, the glottis being freely open, there is no fixed point for the abdominal muscles, and they offer no resistance to pressure by the hand.

The results of palpation are sometimes obscure when the abdominal walls are loaded with fat or infiltrated with serum: when the uterine wall, instead of being supple, is very firm and adapts itself to the ovum so closely that it is difficult to depress it; when the uterus contracts, for then it is impossible to feel or to distinguish the fœtal parts. In this latter case, we simply wait until the contraction ceases. The death of the fœtus may modify the resistance of the tissues. Ascites and dropsy of the amnion, complicating tumors of all kinds, may oppose difficulties. Hyperæsthesia of the abdominal walls, or even pain, may oppose. In such cases, anæsthesia may be invoked.

How to Determine the Size of the Uterus.—The hand is applied flat transversely, its radial edge downward on the hypogastric region. We depress the abdominal wall by pressing, especially with the little finger. We feel a certain resistance, due to the presence of the uterus. Then, the hand in the same position, it is applied from the pubes towards the sternum, using a gentle pressure; when its cubital edge reaches the fundus of the uterus, it sinks above this into the abdominal cavity, and the hand caps, as it were, the fundus uteri.

During the latter months of gestation the consistency of the uterus grows weaker. It gives the sensation of a soft, depressible tumor, whose shape is nearly regular, and whose elasticity is comparable to that of a cyst incompletely filled with fluid. Solid parts are felt inside it of various sizes, which are the different regions of the fœtus. Lastly, there is produced at this epoch a phenomenon which enables us easily to limit the womb and to trace its outlines; these are *the painless contractions* of the organ, recurring at more or less distant intervals, which reveal themselves by an intermittent hardening of the organ, appreciable to the touch and somewhat to the woman.

Important as palpation undoubtedly is as a means of simply diagnosing the pregnant uterus, its value is much greater in its clinical application to the detection of the presentation and position of the fœtus.

Braxton Hicks's Test.—Delicate palpation reveals another sign. Tyler Smith insisted much that peristaltic and rhythmical movements of the uterus could be distinguished. At one time he even thought that mothers and physicians, deceived by these sensations, erroneously attributed them to

movements of the child. Later, however, he recognized the double fact that there were both uterine and fœtal movements.

Braxton Hicks, in 1872,[1] elaborated this sign and raised it to the rank of an important, if not an absolute test. Pinard,[2] Tarnier, and others have verified the contractions of the uterus enlarged by fibroma, and further say that the bladder may contract in a manner to simulate the uterus. Hicks maintains that the movements felt in tumors were brought out by manipulation, and are not of the same constant and spontaneous character as those of pregnancy. He further points out the physiological uses of these movements.

By palpation and gentle taps imparted to the uterine globe we may excite movements, not easy without great practice to assign to the fœtus or to the uterus. The uterine peristaltic wave sometimes roll into lumps, which singularly resemble a projecting knee or elbow.

Still, in some cases where there is so much liquor amnii that the fœtus floats freely, we may by gentle succussions obtain distinctly the phenomenon called *ballottement*. The hands are placed one on either side of the uterus, by one hand you depress rather suddenly the uterine wall, the other hand keeping its place. The following sensations may be perceived: Sometimes the fingers which depress feel the solid body retreat, and sometimes the body returns; the sensation, then, is double; again, the working hand feels nothing, but the opposing hand perceives a light shock produced by the displaced body, which passes over to strike the uterine wall. The conditions producing ballottement and the sensation it imparts may be very closely imitated by putting a hen's egg into a small bladder filled with water; holding the bladder up so that the egg sinks; then tapping the egg at the bottom, so as to displace it upwards. First we feel the egg recede, presently we feel it drop again, impinging on the finger.

How to practise ballottement.—The most effective way, however, of practising ballottement is by the finger applied to the anterior wall of the uterus by the vagina.

First Posture. Place the woman, with the shoulders gently raised, on her back, the legs slightly flexed, and the knees turned outwards. Then pass the index up to the os uteri as a guide to the broad surface of the anterior wall of the uterus. A sense of elasticity, of tension, is felt; then by a sudden tap of the finger-tip strike this part. If the pregnancy be sufficiently advanced; if the fœtus float in sufficient liquor amnii, its body will be felt to rise from the finger and presently to come back upon it, constituting repercussion.

Second Posture. Some authors recommend and figure the standing posture for ballottement, under the impression that thus gravitation acts more readily. This is really an error. In the upright posture the axis of the uterus approaches more nearly to the horizon than it does in the semi-recumbent posture. Little or nothing is gained in precision by adopting an attitude often distasteful to women; and something is lost in convenience and steadiness.

It will be observed that in ballottement there is a double phenomenon. It is compounded of fluctuation and the impact of a solid body floating in the liquid. Sometimes, when the liquor amnii is in excess and the fœtus small, nothing but the sense of fluctuation is perceived. At other times, when the fœtus is large, and the liquor amnii relatively scanty, it is not easy to get ballottement. But instead we have simply the firm rounded anterior wall of the uterus bulging before the pressure of the fœtal head.

The *fallacies* of the ballottement test are not serious. In a case of ascites, an ovarian tumor of moderate size attached by a free pedicle may give a sensation analogous to ballottement. Robert Barnes has also felt the gravid

[1] Obstetr. Trans. [2] Traité du Palper Abdominal, Paris, 1878.

uterus itself move so freely in ascitic fluid under impulse given by the vagina as closely to simulate ballottement of the fœtus *in utero*.

The Objective Signs of the Third Trimestrium.

The signs of the first and second trimestria are further pronounced. The positive signs furnished by palpation, auscultation, and ballottement acquire greater distinctness and value.

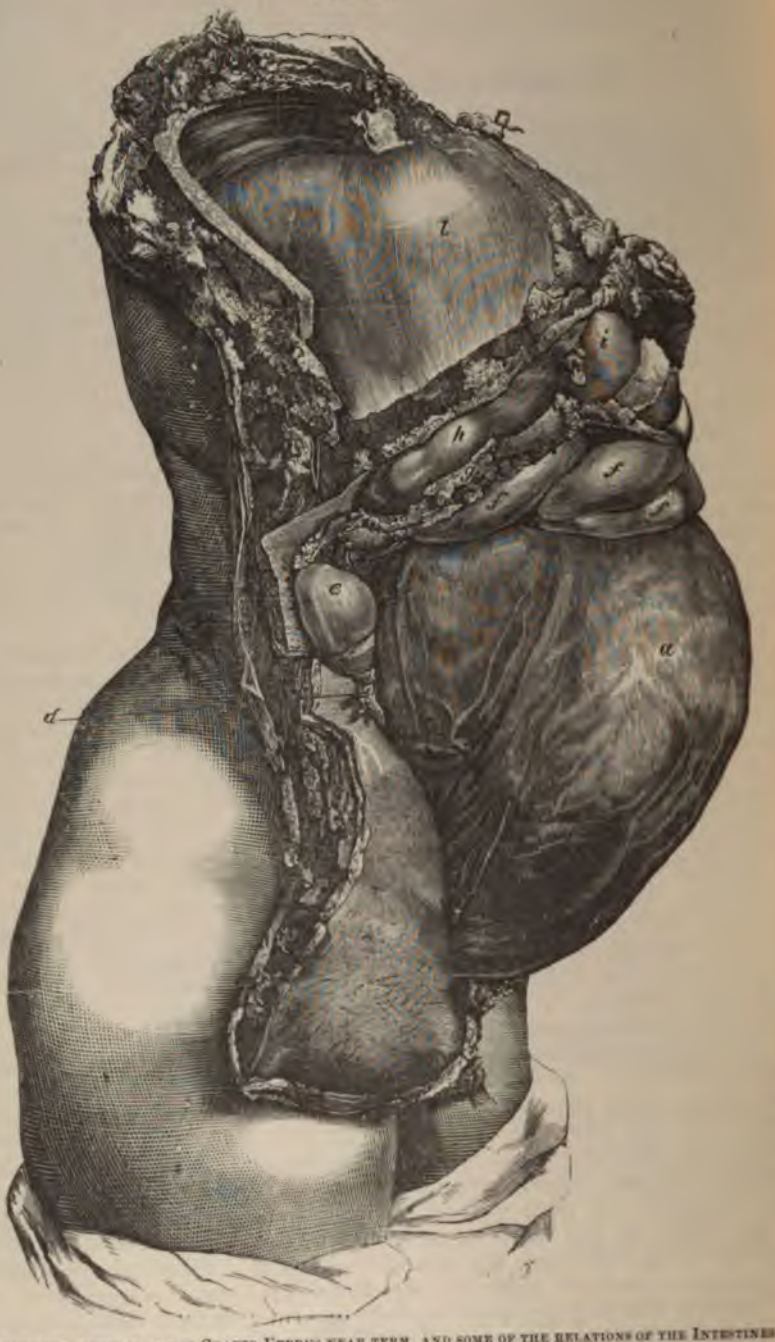
Changes in the Skin of the Abdomen.—*The umbilicus* is said to sink during the first two months. This event, if real, is not of much significance. *The flattening out of the umbilicus* is, however, a sign of real importance. From the middle of gestation, the bottom of the umbilicus rises to approach the level of the abdominal arch. It attains this level at the seventh month. During the two final months the skin of the umbilical cicatrix even protrudes above the surface of the rest of the abdomen. Sometimes the umbilical ring is dilated so as to admit the tip of the finger, and it may even let omentum or intestine protrude, constituting *umbilical hernia*.

Pigment.—In many women the median line of the abdomen presents a brown streak, from three to six lines wide, from the mons veneris to the umbilicus, and sometimes extending above this point. It is most marked in dark women; in negresses it is black as ink. In fair women it may be scarcely perceptible. In dark women the pigmentation extends more or less over the whole abdomen and upper part of the thighs. Sometimes whitish spots are scattered over the dark surface, exactly resembling the spotted areola of the mammæ.

Change in the Musculo-aponeurotic Layer of the Abdomen.—The linea alba may give way under distention; and being separated or stretched the fibres yield and permit the intestines to bulge. Under violent efforts, as in bearing down, *eventration* or abdominal hernia takes place. This weakness is apt to increase at every gestation. It must be met by a well-adjusted belt. In extreme cases, the uterus itself may project through the opening, and fall over the pubes, forming hernia of the uterus.

The Scars, Striæ, or Cracks on the Skin. Striæ Gravidarum (Vergetures, Fr.).—Commonly the skin of the abdomen of gravid women is observed to be furrowed with striæ, chiefly in the region below the umbilicus. They are superficial and slightly depressed. But sometimes they rise above the skin-level. This is said to be due to the infiltrations of the subcutaneous connective tissue, following on compression of the epigastric vein. The striæ are the result of the rapid stretching of the skin under the distention of the growing uterus. It is pretty certain that the *skin grows* to some extent to adapt itself to the new occasion. But the growth of the uterus commonly exceeds the accommodating growth of the skin. Hence the cracks. In a first pregnancy these cracks are rosy or bluish-red, and sometimes are the seat of smart itching. The intervening spaces in fair women are dull white like the rest of the skin; they are brown in dark women, and this color is due to pigmentary deposit. The cracks are usually regularly disposed, forming concentric zones around a centre a little below the umbilicus. In many women they are found on the anterior surface of the thighs, on the buttocks, and on the back. This is evidence of the rapidity of the distention; the skin of these parts is called into requisition. In primigravidæ these cracks are rare and so scattered during the first half of gestation that they are easily overlooked. Towards the seventh and eighth month they become marked. Most frequently new striæ are produced at every new gestation. Thus the greater number of pregnant pluriparæ present recent and old striæ. The first are rosy, the second pale. This may

FIG. 89.



SHOWS THE POSITION OF THE GRAVID UTERUS NEAR TERM, AND SOME OF THE RELATIONS OF THE INTESTINES.
(From W. HUNTER.)

a. Gravid uterus. *d*. Ascending colon. *e*. Kidney. *f, f*. Small intestine. *n*. Transverse colon. *i*. Liver. *l*. Diaphragm

be of some value in legal medicine. But the variations are infinite. Some women never show them. Montgomery saw a woman, mother of five children, quite free from striæ. Credé found striæ wanting in 10 per cent.; Hecker, 6.6 per cent. We have failed after diligent search to find striæ in several cases. If a woman escape in her first pregnancy, she may have the striæ in subsequent labors, especially if she carry twins.

Under ascites, ovarian or other abdominal tumors, or general œdema, the skin may present similar appearances. The striæ then are more general over the abdomen. It might be possible to differentiate the origin of the striæ by noting their special characters.

Similar striæ are often noted on the breasts; these have a similar significance.

Küstner denies that the rete Malpighii is ruptured. By sections he claims to have demonstrated that the rete mucosum is undisturbed, but that the

FIG. 90.

REPRESENTS THE SUCCESSIVE DEVELOPMENTS OF THE UTERUS: 1–2, FIRST AND SECOND MONTHS; 3–4, THIRD AND FOURTH; 5–6, FIFTH AND SIX MONTHS. (ROBERT BARNES.)

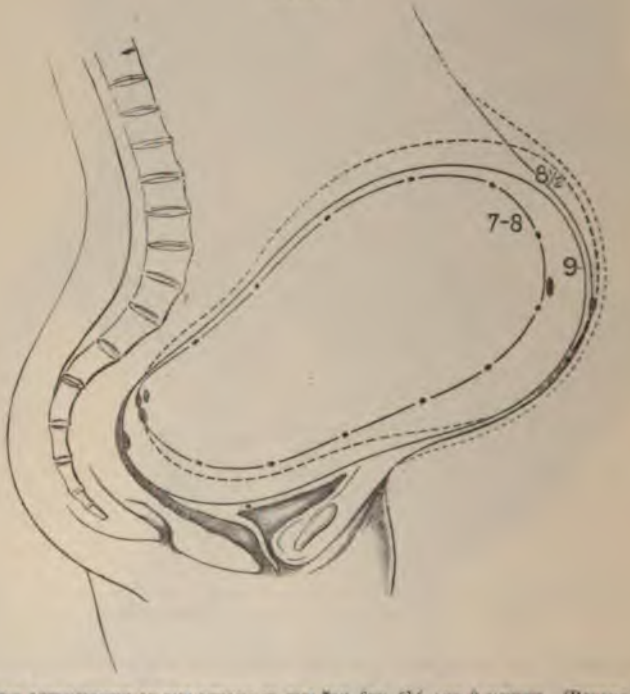
deeper layers of the cutis and the subcutaneous tissue are separated from each other. Langer[1] thus describes what occurs: "The fibre-bundles of the connective tissue of the skin are arranged in such a manner that they cross one another, forming rhomboid meshes the longitudinal axis of which is placed upon the trunk, corresponding somewhat to the direction of the ribs, from the spinal column forwards and backwards. The cutis tissue, therefore, may be the more easily expanded in a direction perpendicular to the long axis of these rhombs than in the contrary direction. In a slight dilatation of the abdomen the distention will occur in this direction, but this is very soon obliterated; it is different, however, when the distention is great: the elasticity of the tissue is thereby destroyed. In the latter case the cutis tissue will obtain a permanently different arrangement." Hence Langer

[1] Medizinische Jahrbücher, 1879.

contends that there is no solution of continuity, but only a permanent disarrangement of the tissue produced by stretching.

Dr. Busey[1] has studied the subject with great care. Admitting to a great extent the accuracy of Langer's description, he maintains that "these striæ and white scar-like spots are not in the pathological acceptation of the word cicatrices." He says: "In view of the histological and pathological demonstrations of the lymph-channel system of the skin, and of the modes of formation of lymph-vesicles on the integumental surfaces (Thilesen, Hecker, Handfield Jones, Biesiadecki, Odenius), the presumption is strongly justified that the statement of Schultze, that striæ are occasionally developed into vesicles in œdematous conditions of the abdominal integument, the serous infiltration of striæ frequently observed, and the vesiculation which Küstner asserts is the ordinary condition of the striæ during the earlier days of puerperal convalescence, are due to disturbances of the circulation in this system of vascular channels and tissue interstices."

FIG. 91.



TO REPRESENT DEVELOPMENT OF THE UTERUS IN THE 7TH, 8TH, 8½ AND 9 MONTHS. (ROBERT BARNES.)

When the distending cause is removed, the skin falls into loose folds and furrows, often œdematous. The striæ become pale, shrink a little, but never quite disappear. Old striæ become white, and when again disturbed by a new gestation they present a glistening pearly appearance.

Appreciation of the Value of these Striæ for Clinical and Medico-legal Purposes.—1. The presence of striæ gives no absolute proof of pregnancy past or present. 2. The absence of striæ is not trustworthy evidence that the subject is not, and has never been, pregnant. 3. The presence of striæ on the lower abdomen of the characters usually noted offers strong presump-

[1] American Gynecological Transactions, 1879.

tive evidence of present or past pregnancy, and points to the expediency of seeking controlling testimony.

Diagnosis of the Stage of Gestation.—Having determined the existence of pregnancy, the next point, often of great practical importance, is to determine how far the pregnancy is advanced. The investigation of this question is based upon the successive appearance of particular signs at or near particular dates; and mainly upon the degree of development of the uterus.

Setting aside the subjective signs, we may set forth the leading objective signs in tabular form.

Figs. 90, 91, will serve to realize some of the changes of sign and position set out in the table.

TABLE TO INDICATE THE PERIOD OF GESTATION ATTAINED.

Month.	Body of uterus	Changes of uterine neck.	Some functional changes.	Particular characters.
1st and 2d	By double touch felt enlarged in anteversion, vaginal roof-stretching. Fundus felt on level of or above symphysis at end of 2d month.	Softening of os tincæ; slightly open in pluriparæ. It is raised towards sacral hollow, or under promontory.	Breasts swelling; areola becoming darker.	Turgescence of vaginal portion, of vagina and vulva (by speculum), and creamy secretion.
3d and 4th	At end of 3d month fundus above level of symphysis; at end of 4th month it is halfway between pubes and umbilicus.	Softening of os more marked; more open in pluriparæ.	Swelling of breasts more marked; pigmentation more marked; erectility of the nipple.	Vascular turgescence more marked. Uterine souffle sometimes heard. Movements of uterus sometimes felt.
5th and 6th	Hypogastric prominence marked. Fundus at end of 5th month felt a finger's breadth below umbilicus; at end of 6th month a finger's breadth above, inclining to right.	At end of 6th month the lower part of vaginal portion softened. Os in pluriparæ more open.	Œdema and varices sometimes appear. Breast-signs more marked; areola spotted; Montgomery's tubercles.	Palpation; movements of fœtus; ballottement. Uterine souffle, fœtal heart. Umbilicus nearly flat; brown line. In primiparæ head sometimes in pelvis.
9th month, 1st half	Fundus rises into epigastric region, and under edge of false ribs of right side.	The whole length of the neck softened. In primiparæ os now slightly open.	Breast-signs still more marked.	Ballottement now rarely distinct, but head is *lifted up*.
2d half	The fundus drops	Os internum softens and opens a little in multiparæ.	. . . . .	Head more or less engaged in pelvis.

The Pathological States which Simulate Gestation.—The study of the objective signs of gestation we have made will almost always enable us to arrive at a definite conclusion, positive or negative, under simple conditions; that is, where gestation is simple, or where an abdominal tumor exists alone. The really difficult cases are those in which the gestation is abnormal and those in which a uterine gestation is complicated with tumors or other forms of abdominal disease.

We may first of all dispose of those cases of *simply simulated gestation.* The most frequent of these is that condition called, since the time of Mason Good, *Pseudocyesis* (from ψεῦδος false, κύησις pregnancy).

(A) The most familiar variety of this is the pseudocyesis of the menopause, or the CLIMACTERIC PSEUDOCYESIS. Just when the reproductive faculty has disappeared, under the aberrant nervous freaks which mark the menopause, the woman, eager to retain the parting proof of motherhood, construes every sensation and every symptom as evidence of that state which she hopes or fears may exist. Nor are signs wanting to lend force to her conclusion. There are even objective signs which may impose upon others, as well as subjective signs which to her are often absolute. Under ordinary conditions we place little reliance upon subjective signs. Under no conditions are they more illusory than here. We may, then, in the case of a woman of fifty or thereabouts disregard the irregularity or suspension of menstruation and her assertions that she feels swelling of the breasts and the movements of the child, although she may honestly believe in them. Seeking for objective evidence, we find two signs which deserve attention. These are—1. The frequent enlargement of the abdomen. 2. The sensation on palpation of movements. The enlargement is commonly due to accumulation of fat in the omentum and abdominal walls, and to distention of the intestines by air. It is usually not difficult to judge the situation. The woman lying on her back, the abdominal walls relaxed by flexing the thighs, percussion elicits resonance, somewhat muffled it may be, where the gravid uterus would yield nothing but dulness. Inspection usually recognizes a flatter and flabbier abdomen, and the umbilicus is rarely effaced as in pregnancy. Palpation gives the doughy sensation of fat, and the hand, grasping up a mass of abdominal wall, may commonly be pressed down so as to feel the spinal column and the pelvic brim no uterus opposing. Should the abdominal muscles be rigid under reflex or voluntary action, Simpson's plan of giving a little chloroform removes all opposition, and enables one to make a perfect exploration. Then there is the vaginal touch. The senile uterus of the menopause is characteristic; it is small, the vaginal portion is small and hard, less projecting in the vagina, and the os externum is becoming smaller and rounder. Such a uterus is unfit for gestation. Should conception occur, as it sometimes does, the end is abortion. The evidence here is all negative. The breast signs are rarely so marked as to deceive. The woman is only big with fat and wind.

The physician may have convinced himself, but the woman may still cling to the fond delusion, even for much longer than nine months. The obstinacy of the delusion sometimes assumes the character of insanity. Dr. Crichton Browne relates a remarkable example of a woman who not only could not be shaken in her belief that she was pregnant, but even went so far when her time was up as to fall into simulated labor, which evoked a sanguineous discharge, an example of the force of the imagination directed to a particular organ.

A variety of pseudocyesis of which we have seen some striking examples is that which sometimes occurs in young women who either fear or hope they may be pregnant. We have seen cases where, without any motive to

deceive, recently married young women have been firmly convinced that they were pregnant. Menstruation not seldom is suspended under the emotions and other changes attending married life, although there be no conception. The wise rule in all cases of doubt is to suspend definite judgment for a month, and to watch the development or subsidence of the symptoms suggestive of gestation. Appeal to Time, the great solver of mysteries.

(B) Fibroid or other Morbid Enlargement of the Uterus.—If the uterus be quite smooth, regular in shape, and rising above the symphysis, it may simulate the enlargement of gestation. But a fibroid is usually hard in texture; it does not, except in rare instances, give the sensation of peristaltic movement, it is not elastic like the gravid uterus. A sound synchronous with the mother's pulse is sometimes heard in one or the other groin, but not always, and the fœtal heart never. Then the vaginal touch and the speculum give only negative answers to the questions of softening of the vaginal portion, the color and creamy discharge of the vagina. And Time again will solve the doubt, by showing that the progress of the tumor differs from the steady evolution of the uterus under gravidity.

Remanent Enlargement from Subinvolution of Past Gestation.—This may or may not be attended by menstruation. The positive signs of gestation will be wanting.

Enlargement from *hæmatometra*, as from occlusion of the vagina. This condition may simulate gestation by the size of the uterus and its position. But other features differentiate the two states. In retention of the menses from occlusion of the cervix uteri or vagina, menstruation has never appeared by external flow; the obstruction will be recognized on examination; and there is commonly evidence in the dirty complexion, febrility and wasting, of absorption of altered blood-elements.

Functional modifications of the uterus, as amenorrhœa, often the first sign to suggest pregnancy. When not due to gestation, the small size of the uterus will declare the state of the case.

Menorrhagia may exist with gestation and cause embarrassment. In the intervals of the flow, examination will reveal the positive signs of gestation.

(C) Extrauterine tumors give rise at times to doubt. Of these, *ovarian tumors* are the most frequent. They may have the following points in common with pregnancy: (1) size; (2) shape; (3) corresponding area of dulness; (4) a sound in one groin simulating the uterine souffle. They will differ in one or more of the following characters: (1) The size will be likely not to correspond in equable rate of development—that is, a size like that of eight months' pregnancy will have been reached by an ovarian tumor in a shorter or in a longer time; (2) the shape will rarely be so uniform, irregular lumps are commonly felt; (3) there is often fluctuation; (4) the souffle is not so likely to be heard; (5) the fœtal heart will not be heard, nor will the other positive signs of gestation be found; (6) the patient, instead of the "mask of gestation," will probably exhibit the "*facies ovariana.*"

(D) Small ovarian tumors getting into the pelvis behind the uterus may cause difficulty. The feel of the vaginal portion of the uterus, hard; its position, pushed forward by the tumor; the absence of the proper signs of gestation; the sensation of a tense bag—the ovarian sac—in Douglas's pouch; and, if the conditions warrant it, the use of the sound by which the size and relations of this organ may be accurately fixed, are points which will generally clear up the case.

The observations also apply to *small dermoid cysts.* Occasionally it is desirable to explore these retrouterine cysts by the aspirator-trocar. In this case, the examination of the fluid drawn, the collapse of the cyst, and the retreat of the uterus to its normal position, establish the diagnosis.

(E) HEPATIC CYSTS, ABSCESS OR HYDATID, or enlargement of liver from other causes, may be so large as to invade the entire abdominal region, and under certain concurrent conditions may suggest the idea of pregnancy. The hydatid cyst yields free fluctuation and the characteristic "thrill."

(F) RENAL CYSTS may give rise to the same doubt. Both may almost be excluded as against gestation and ovarian tumors by this simple physical test. Hepatic and renal cysts develop from above downwards, whilst gestation and ovarian tumors develop from below—*i. e.*, from the pelvis upwards. Percussion and palpation, therefore, will rarely fail to show that in hepatic and renal cysts there is no line or area of resonance immediately below the ribs or in the epigastric region, except in renal cysts still so small as to give no resemblance to gestation; and, on the other hand, an area of resonance will commonly be made out below the cyst, between it and the pelvis. And pelvic exploration will complete the diagnosis by showing that the cyst is not of pelvic origin.

Ovarian tumors and gestation yield dulness from the pelvis upwards, and rarely fail to leave a resonant area between their upper margin and the epigastric region.

(G) ASCITES will sometimes have to be distinguished from gestation. To do this we may (1) examine heart, lungs, liver, and kidney to determine if there is any organic disease likely to cause ascites. This course is the more indicated because in any case of a gravida suffering, these organs should be carefully examined. (2) Inspection of the abdomen in dorsal decubitus will commonly show a flabbier, less prominent abdomen—it bulges at the flanks. (3) Palpation gives freer fluctuation than is found in gestation. (4) Percussion declares a resonant area at the highest point, and this area is either circular, or *its upper margin is concave*, the *concavity upwards;* the reverse being the case in gestation and ovarian tumors, in which the *area of dulness is convex upwards.* (See Figs. 92, 93, 94.) Again, there is dulness in the flanks, and the area of resonance changes with the posture of the subject. Tapping by an aspirator-needle may be practised in doubtful cases.

Enlargements of the spleen and omental tumors may at first be mistaken for gestation; but search for the characteristic signs of gestation ought to lead to a right conclusion.

By careful exploration, conducted on the lines above indicated, the skilled observer will rarely fail to arrive at a correct diagnosis when the question lies in its simple form as of gestation or not gestation.

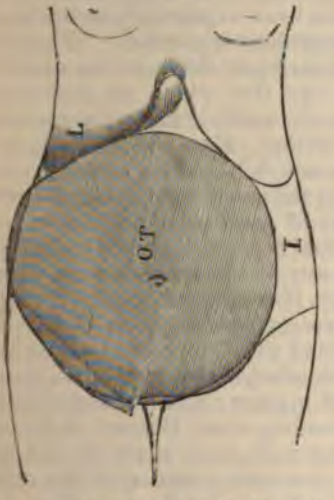
But *when the question is complicated*, when the case comes before us of uterine gestation *plus* one of the conditions stated, the difficulty is often great. We shall seldom, perhaps, fail to make out *one* of two conditions present, say gestation and ascites, or gestation and ovarian tumor, but there will be the probability of our coming to the erroneous conclusion that the condition detected is all, the complicating condition being overlooked. The fact is, one condition will often assume predominance and mask the other condition. The concealed condition may nevertheless undergo dangerous development in itself, or act injuriously upon the other condition.

The complication of uterine gestation with uterine fibroids is one of intense clinical interest. Here also the fibroid may have been known before the gestation supervened. Then the developmental stimulus imparted to the uterus seizes upon the tumor as well. The enlargement is disproportionate to the date. The contour of the uterus will probably be irregular. The position in the abdomen will present a deviation from the normal.

Uterine gestation complicated with ovarian tumor. The uterus and the tumor both grow. Thus the enlargement of the abdomen is more rapid than from simple gestation. Distress is greater, often becoming urgent from the

crowding of the abdominal and thoracic viscera. The tension of the abdominal walls is greater. The shape of the abdomen is different; it is wider across, and generally a deep fork or depression may be seen or felt at the upper part where the uterus and tumor diverge, and a sulcus or line of demarcation may sometimes be felt, extending downwards. By palpation and auscultation we may make out the outline or the head of the fœtus and hear its heart. The uterus will be pushed on one side by the tumor, so that the fœtal heart will be heard at a distance from the median line. The tumor on its side may yield characteristic fluctuation. By vagina it may not be pos-

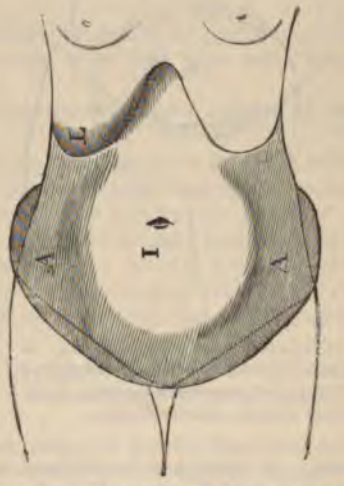
FIG. 92.



REPRESENTS THE AREA OF DULNESS AND FLUCTUATION IN OVARIAN TUMOR. (ROBERT BARNES.)

♀ T. TUMOR. L. LIVER. I. INTESTINE.

FIG. 93.



REPRESENTS AREA OF DULNESS SHADED, AND OF RESONANCE IN ASCITES. (ROBERT BARNES.)

A A ASCITES. L. LIVER.

sible to make out ballottement, from the uterus being pushed up out of the pelvis. But the speculum will, if the fœtus be alive, exhibit the color and discharge characteristic of gestation.

Encysted peritoneal dropsy or abscess may present features similar to those of ovarian cysts. The diagnosis of extrauterine gestation complicating uterine gestation may be extremely difficult. Perhaps the extrauterine may have been known before the uterine gestation supervened. In such an event the problem is easy. But a woman may present herself for the first time the subject of the complication. The following rule applies usefully here, and in many cognate cases. First, examine in the usual way to establish the existence or absence of gestation. If gestation exist, it ought to be made out by its positive signs. And we shall generally be able to estimate approximately the date of the gestation. This point established, we then consider how far the enlargement and other features observed are accounted for by the gestation. The excess of size and abnormal features must be assigned to another cause, and if by a process of elimination we can exclude ovarian, hepatic, renal, and uterine tumors, we approach a solution, which, if not absolute, will still be of clinical value. But it must be confessed that there are few things more difficult than to differentiate some cases of partly solid, partly fluid, ovarian tumors from abdominal gestations. Practically this

indecision is the less important because our action would, in either case, probably be the same—namely, to operate upon the tumor.

Gestation is sometimes complicated with ascites. This may happen either from preëxisting ascites, the result of Bright's disease, or in connection with albuminuria arising during the gestation. We have seen cases of ascites combined with fibroid enlargement of the uterus very hard to distinguish from the uterus enlarged by pregnancy. And we have seen the gravid uterus of four, five, and six months, so floating in ascitic fluid that the usual exploratory means of search for gestation were baffled. We could get a ballottement of the uterus itself in the fluid, like that which we sometimes get when an ovarian tumor is complicated with ascites. Here the history may lend important help. The presence of albumen in the urine, together with a rational history of gestation supported by some of the usual signs, will justify a diagnosis.

Fig. 94.

Represents the differentiation of ascites and ovarian tumor by the convex outline of ovarian tumor and the concave line of ascites. (Robert Barnes.)

In any of the foregoing questions, the history, if it come to us as the record of observations made by competent persons, may lend valuable, perhaps decisive aid. It will always give a clew to guide the line of inquiry; unfortunately sometimes a misleading clew. History, rightly called a lying jade, then must not be trusted alone. It must not be allowed to bias our interpretation of the objective evidence, which, after all, is the only solid foundation for a verdict.

Gestation may be attended by a distended bladder. This will be discussed in connection with retroversion of the gravid uterus.

The diagnosis of gestation continued after the death of the embryo or fœtus is often difficult. The active signs of gestation have subsided—that is, the deep color due to vascular fulness, and the auscultation signs are lost, the breasts fall; the uterus ceases to grow; ballottement is frequently lost from disappearance of liquor amnii. This subject will be again treated of under "Abortion."

The Duration of Gestation.

This is still, and will probably long continue to be, a vexed question. That doubt should still exist upon such an integral event in human life, one that has always arrested vulgar and scientific interest, is enough to show how difficult is the problem. And not only this: it raises the strongest presumption that the duration of gestation in woman is a variable period. Still there must be limits; and these we must endeavor to determine as nearly as possible.

Harvey, the Immortal, thus expresses his opinion: "Unquestionably the ordinary term of utero-gestation is that which we believe was kept in the womb of his mother by our Saviour Christ, of men the most perfect; counting, namely, from the festival of the Annunciation, in the month of March, to the day of the blessed Nativity, which we celebrate in December." This is a period of 275 days. "Prudent matrons, calculating after this rule, as

long as they note the day of the month in which the catamenia usually appear, are rarely out of their reckoning; but after ten lunar months have elapsed, fall into labor, and reap the fruit of their womb the very day on which the catamenia would have appeared had impregnation not taken place."

The Jewish law and experience supply the most authentic general experience. The Rev. Isaac Samuel gave us in 1870 the following statement: "The Talmud fixes the maximum period of pregnancy at 271 days, and as extending sometimes to 272 or 273 days." Robert Barnes, after large experience, is able to say that Jewish women are more correct in their reckoning than those of other races, and that it corresponds closely with the period assigned by the Talmud.

In France 270 days is held to be the usual duration of gestation. The Napoleonic code admits legitimacy of a child born 300 days after cohabitation.

In Norway Faye and Vogt give 270 days as the mean, estimated from presumed fruitful intercourse in 63 cases.

Raciborski, in five cases of presumed single coitus, records labor as taking place in 268 and 275 days. Montgomery, in seven cases, cites longer periods, from 280 to 291. But these, Simpson says, were selected as proof of the prolongation of pregnancy. They are so much at variance with facts more rigidly controlled that they may safely be set aside. Reid ("Lancet," 1850) studied this question with great care. He notices twenty-five cases; labor came on at from 265 to 280 days, with the exception of one at 287 and one at 293 days.

Veit[1] tabulated a mass of observations in regard to the interval between the end of menstruation and parturition. The average interval was 278.5 days.

Hohl[2] says that in young healthy women pregnant for the first time, labor sets in only a few days, two or three, before the 280th day, or exactly on that day, rarely earlier.

The solution has been sought in the history of *pregnancies ensuing upon a single coitus*. If a considerable number of well-authenticated cases of pregnancy so started and ending in the birth of a live mature child could be collected, we should approach nearer to a solution than by any other evidence. Easy as this is in cows and mares, difficulties innumerable surround the attempt to arrive at trustworthy facts in the case of women. The facts cited are few in number, and mostly open to question. Collections may be found in Montgomery, Ahlfeld, Faye, Clay. Some have been cited. But if all were summed up, the total would still be too small to be of material value, on account of the many fallacies which beset them. They, however, support the evidence derived from other sources helping to fix the normal term of gestation at from 270 to 275 days.

The history of *pregnancies presumedly dating from the first coitus*, as after marriage, is freer from some of the fallacies which beset that from an assumed single coitus. The day of marriage, and hence of the first coitus, is commonly fixed during the first week after a menstrual epoch, and is undoubtedly in many cases a fruitful one. A careful collection of cases in which menstruation did not reappear after the period immediately preceding marriage would furnish valuable evidence. In the few cases observed by Robert Barnes the birth of a mature child followed at 270 to 275 days, again confirming the testimony from other sources.

In recording such cases especial care must be taken to note that the child

[1] Brit. and For. Med.-Chir. Rev., 1854. [2] Geburtshülfe, 1862.

is born mature, and that an ordinary menstrual epoch occurred immediately before the marriage. It sometimes happens that a mature child is born at seven or even six months after marriage. But subsequent children by the same parents take the usual time of nine months to attain maturity.

One case is worth relating from its probable precision. A lady who had been married several years without issue, the cause being a contracted os uteri externum, was operated upon by Robert Barnes on December 1. Marital intercourse for the first time after the operation took place soon after the succeeding menstruation—*i. e.*, on December 15. The catamenia appeared very slightly on January 6. She was delivered of a healthy mature boy on October 3—that is, after 270 days' gestation.

It has been supposed that a new departure from which to calculate pregnancy may be found in the *sensation of the movements of the fœtus—quickening*—and that this event may serve to control the calculation based upon the last menstrual epoch. It is too fallacious to be trusted. 1. The sensations are illusory. Some women believe or declare they feel the child when there is no child. This subjective sign is the most fondly cherished by women who are past bearing. 2. Some pregnant women never experience it. 3. The date when the first sensation is perceived varies greatly. Ahlfeld found that in forty-three cases it ranged from 108 to 134 days, and in others to 159 days after the last menstruation. Veit gives one case at 79 days, and the average about 132 days.

Argument drawn from *unusual development of child* is of little value. Bigger children than any produced after alleged protracted gestation have been born within the ordinary limits. Robert Barnes has known one child born at ordinary term to weigh eighteen pounds. And children supposed to be born after protracted gestation have been below the average weight.

Charles Clay contended that *the duration is regulated by the ages of the parents*, and deduces that the longer gestations are observed in the older women. This agrees with observations on cows.

The observations of Faye, Hecker, and Ahlfeld do not correspond as to *the relative duration of gestation in primiparæ and in pluriparæ*. Observations made in hospitals are open to fallacy. Where frequent examinations are made, and other hospital influences act, premature labors are easily provoked.

Is there a special individual gestation period? This is not improbable. If there be a special menstrual type, there may also be a correlated gestation type. A woman who menstruates every thirty days may be supposed to carry longer than one who menstruates every twenty-eight days. Thus we may have a gestation consistent with the most widely received theory lasting 300 days. Is this in accordance with experience? It is certainly not universally true. Women, howsoever long the intervals of their menstruation, still calculate correctly the day of labor at 270–280 days from the last menstruation.

Dewees, Hamilton, and Retzius (see Simpson) record instances of apparent protraction recurring in the same woman, and as an hereditary peculiarity in a mother and two daughters.

The strongest case observed by Robert Barnes was that of the wife of a physician, who was confidently believed by her husband, who dated from a last menstruation and checked the calculation by the quickening, to have carried her child on two occasions a month beyond the ordinary time. The children, of excessive size, weighing ten and twelve pounds, were lost in labor. Robert Barnes was consulted when she was thought to have completed nine months in the second pregnancy, with a view to bringing on

labor and getting a live child. He attended her in labor a month afterwards. The husband was of mature age, the wife approaching the climacteric.

The argument of analogy has been appealed to. What is the teaching derived from the *observation of other mammalia?* The mare and cow, domestic animals whose whole life is under observation and control, seem to offer especial facilities for giving precise dates. The experiments of Tessier, Lord Spencer, and Krahmer are constantly cited. They are full of interest.

The gestation period of cows approaches most nearly to that of women. It averages 285 days from coitus. The instances in which 301 days were exceeded were extremely rare. It appeared that bull-calves were carried a little longer than heifers; and when an aged bull covered, the period was longer. It was also found that the youngest cows went the shortest time. These observations are supported by records of 641 cows ("Buffalo Med. Journ."). Of these, 50 calved between 260 and 270 days, and these were all heifers on their first calf.

Too much importance has been assigned to this argument. Granted that the duration of gestation in cows is variable, and even protracted in some cases, it would not settle the question as concerns woman.

Latitancy, or the lying in wait of the ovum and spermatozoa for each other, has an important bearing on the question. This hypothesis postulates that coitus or insemination may take place some days before the spermatozoa meet the ovum to fecundate it; or that the ovum may be kept in the tube some time waiting for the spermatozoa. That the spermatozoa can retain their vitality for some time out of the body is proved by the experiments of Spallanzani, who impregnated frogs, and John Hunter and others, who impregnated mammalia by artificial injection of sperm. Stored in the congenial soil of the female genital passages, it is established that the spermatozoa preserve their movements for several days; Valentin says for a week or more. Haighton's experiments on rabbits showed that the conjunction of the ova and semen did not take place under two days. De Graaf, Cruikshank, Saumarez, Bischoff, believed that vivification of the ovum does not take place immediately on coition, but after an uncertain interval. Bischoff says it can scarcely be doubted that the time occupied by the transit of the ovum and the preparatory changes in the mucous membrane differs greatly in individuals, and hence, entail a longer or shorter duration of pregnancy. Bischoff, Prevost, and Dumas have seen the movements in the sperm in the Fallopian tubes of the bitch and rabbit seven or eight days after copulation. Percy, of New York, says that he collected live spermatozoa from the neck of the uterus of a woman eight days after the last coitus.

The evidence of latitancy of the ovum is not so precise. The ovum probably soon perishes if not fecundated. Bischoff favors the idea that impregnation takes place *on* the ovary, and thinks that, unless it take place before the ovum has made much way in the tube, its capacity for impregnation is lost. Coste thought impregnation takes place *in* the ovary.

Allowing six or seven days for latitancy—and there is little or no evidence to show that a longer time may be granted—it will account for gestation being protracted to 285 or 287 days. This confirms the law as to the definiteness of the period of gestation.

Hohl[1] especially insists upon the non-coincidence of the time of coitus with that of fructification as a disturbing factor in the calculation of the gestation period.

Dr. Duncan,[2] pursuing this theme (1854), has much insisted upon the dis-

[1] Geburtshülfe, erste Ausgabe, 1855.
[2] On Fecundity, Fertility, and Sterility, 1871.

tinction between insemination and gestation, contending that gestation proper can only date from the moment of fertilization of the ovum, and not from the coitus. Joulin[1] also insists upon this distinction.

This argument has been pursued in another form by Stadfeldt (1875), Kundrat and Engelmann, Williams, Schroeder.

Stadfeldt calculates—1. From the last menstrual period in twenty-six cases; this gave a mean of 280 days, the shortest being 244 days, the longest 304 days, and therefore a range of sixty days. 2. In twenty-four cases he tried to fix the epoch of the first suppression. The mean calculated from this day was 254 days; the shortest, 240 days; the longest, 273 days; range, 33 days. If one admits that fecundation took place eight or ten days before the first menstrual suppression, the mean duration of the gestation from the physiological point of view could, according to Stadfeldt, vary only from 260 to 264 days.

J. Williams,[2] from 16 cases, concludes that the rupture of the follicle and escape of the ovule take place before the appearance of the corresponding menstrual flow. It is contended that the processes which might fix the ovule of this period in the uterus have passed, and that, therefore, the ovule which brings the gestation belongs to the next ovulation, which is not attended by hemorrhage. Williams, then, not content with one week's latitancy of the sperm, postulates one to three weeks—that is, insemination takes place one to three weeks after a menstrual period; that the sperm is stored up in the infundibulum of the tube, waiting for the ovule, soon after its extrusion—that is, just before the next menstruation. This hypothesis, again, would reduce the term of gestation proper by from one to three weeks.

Against this there is the strongest presumptive evidence that conception may take place during menstruation; that the most commonly successful intercourse takes place within a week after the cessation of menstruation—that is, at the time sanctioned by Jewish custom, "after the bath;" and that —and upon this point Robert Barnes speaks from frequent observation—when the next period is due, and when the time is only just past, all the objective signs of early pregnancy are characteristically developed, which means that conception took place two or three weeks before the suspended menstrual epoch. It is also highly probable that there is no strictly fixed time for the escape of a ripe ovum.

After all, it must be seen that howsoever just may be the distinction between insemination and conception from a purely physiological point of view, it gives little or no help in the solution of the social, medical, and legal problems connected with pregnancy. Of what avail, for example, is it to a husband, a physician, or a lawyer to be assured that a woman delivered of a mature living child had only been 250 days in true gestation, when stubborn facts testify that she had cohabited a month earlier?

Again, is Science prepared to advise Law to accept as legitimate a child born, say 300 days after legitimate intercourse, on the ground that legitimate semen might have been sown 300 days or more before the birth? If such a doctrine be accepted, Science must resign her authority, and questions of chastity must be decided by detectives and ladies' maids.

Admitting that there may be a marked interval between insemination and conception, this interval is not known; it is probably variable. The rational way, then, is to merge this unknown quantity in the gestation-period, regarding it at most as a preliminary stage of the gestation.

Amongst those who admit protracted gestation are J. Y. Simpson, who relates four cases of apparent protraction to 336, 332, 329, and 324 days;

[1] Traité d'Accouchement, 1867. [2] Philosophical Transactions, 1875.

Atlee, who gives two cases in which the subjects went through the entire calendar, or 365 days; and Merriman, whose longest case was 309 days.

Duncan concludes "that while absolute proof of the prolongation of real pregnancy beyond its usual limits is still deficient, yet there is evidence to establish the probability that it may be protracted beyond such limits, to the extent of three or four weeks, or even longer."

Moreau gives a case in which he believed a lady went 328 days. The observation was controlled by movements of the fœtus and attempt at labor a month before delivery.

On the other hand, Gooch, Ch. Clarke, and David Davis did not believe in protracted gestation. Stoltz says labor cannot be protracted beyond fifteen days, taking 270 or 280 days as the normal term. He says the French law, which allows 300 days, is extremely liberal. Depaul is of the like opinion.

Kleinwächter[1] says the duration of pregnancy is 280 days, and that there is no protracted gestation. In a trial before Cockburn, C. J., in which Tyler Smith and Robert Barnes gave evidence, Tyler Smith distinctly denied protracted gestation.

There are several sources of fallacy that may disturb calculation. (1) We can rarely fix the date of the fruitful coitus. (2) Sir James Simpson recalls the fact that the caduca is not at first a closed sac; the tubes open into it, as well as the os uteri internum. Hence it is not impossible that the ovule of a first conception may be disorganized without the caduca being broken up, whilst a second ovule may come into and be grafted upon the caduca already formed. Then a catamenial period might pass without flow, and an excess of three or four weeks in the calculation would be made. (3) Menstruation may be suspended from other causes a month or two before conception. Some women do not menstruate from one pregnancy to another. Women continuing to suckle may have one menstrual show, then suppression, and may wrongly assign this to pregnancy. (4) Stoltz contends that fecundation may take place a little before a menstruation is due, and suppress it. If, then, we count the gestation as beginning immediately after the last menstruation, we count fourteen to twenty-one days too many. Thus, a gestation really of 273 days may appear to be of 293 days or more. Robert Barnes has reason to suspect that this often happens. Having diligently compared, when in charge of a lying-in hospital, dates of expected and of actual labor, he found that in a large proportion the women came in at periods ranging from a week to three weeks after expectation. (5) Labor may be protracted several days. Thus it may be fairly or apparently started a week before it is completed. And the gestation would be protracted by this week.

J. Y. Simpson suggests that the state of health and activity of the uterus may sometimes lead to the postponement of labor.

Hohl says that no fixed period of gestation can be determined, because (1) the ripening of the ovum in the ovary does not take an equal time in all women; (2) the ripe ovum does not always quit the ovary at a fixed time; (3) the coitus is not always effected at the time when the ovum lies ready for fertilization, which may be shortly before or immediately after menstruation; (4) the spermatozoa may meet the ovum in the uterus, or tube, or upon the ovary, and this will make a difference in time; (5) all children do not mature in equal times.

We may safely conclude that Nature's law, which prevails in all other things, prevails here; that this law, which in all other things works with so

[1] Grundriss der Geburtshülfe, Wien, 1877.

great uniformity, works with uniformity here; that evidence drawn from every variety of source establishes as the law of gestation a duration of from 270 to 280 days; and therefore that any wide departure from this limit must be looked upon as at variance with Nature's law, and not to be accepted without rigorous proof. In this question of the duration of pregnancy it is surely wiser to treat an alleged case of protracted gestation as deceptive than to believe that Nature's law has been suspended for the occasion. We shall do well to remember that in cases of alleged protracted gestation which are made the subjects of forensic discussion, strong motives exist for making out the particular case.

The contest lies between Science based upon the rigorous compulsion and comparison of innumerable facts, and Assumption resting upon a few facts, often tainted, the reality of which is rarely if ever clearly established. Science on the one hand represents general law, Assumption on the other hand rests upon doubtful exceptions.

We may state the following propositions as approximately true:

1. A well-developed child will have been carried at least 260 days from the fruitful coitus. And the appearance of a well-developed child even at the 260th day is exceptional, and justifies doubt as to the accuracy of the date of coitus.

2. The most common time observed for the delivery of a well-developed child is from 270 to 275 days from the fruitful coitus.

3. A not uncommon time observed for the delivery of a well-developed child is from 275 to 280 days from the fruitful coitus.

4. Cases of children apparently carried more than 280 days are exceptional, and every day exceeding 285 renders the accuracy of the computation more and more doubtful.

5. Cases of children alleged to have been carried more than 290 days must be regarded as apocryphal until verified by absolutely unimpeachable evidence.

It is difficult to fix the *ultimum tempus pariendi*. It is more difficult still to fix the limit of audacity prompted by cupidity. The function of Science and of Law is to take care that the duration of pregnancy shall not be extended to suit the ends of interested audacity.

The prediction of the day of labor is a point of interest in every pregnancy. The physician is continually called upon to give a definite answer to it. The experience of mankind has led to fairly approximate calculations.

1. Where a single coitus is admitted, count 270 to 275 days. The latter date will rarely be exceeded.

2. In the ordinary social relations, reckoning is made from the beginning or the cessation of the last menstrual epoch. The most usual plan is to count from the last day of the period. Count 275 days on the calendar from this date, and labor may be expected within a range of a week earlier or later.

Tyler Smith contrived an ingenious dial, which he called a "Periodoscope," to assist in these calculations. It is based on the theory that 280 days is the normal duration of gestation, and that the menstrual or ovulation nisus determines the expulsive action of the uterus. His periodoscope thus indicates the most probable epochs for abortion and premature labor.

Schultze also constructed a dial for calculating the day of labor. It is copied in several recent text-books. It is not reproduced here, because the method of counting the days on the calendar is not less simple and accurate.

The Limits of the Capacity for Reproduction in Woman.

The earliest age is announced by the appearance of menstruation. It is not common for English girls to become mothers earlier than at sixteen or seventeen years. This does not exclude the possibility at an earlier epoch. Social laws to a great extent account for the rarity of very early maternity in England. Roberton recorded the case of a girl who became pregnant in her eleventh year. When in labor she had convulsions, but was delivered without difficulty of a full-grown stillborn child. Smith, of Coventry, relates a case of delivery at term of a living child at twelve years seven months. Dr. Wilson, of Glasgow, records a case of delivery at thirteen years six months. Henry Dodd, of Billington, York, in "Lancet," 1881, records the following: On August 8, 1871, he attended a woman when she was delivered of a female child. This child menstruated more or less regularly from the age of twelve months until June 22, 1880, when, on her mother's statement, she became pregnant. She was delivered by Mr. Dodd, after an easy labor, of a live child weighing seven pounds, on March 17, 1881, just 147 days before she had reached the age of ten years. The girl had free hirsute growth on the pubes and in the axillæ; the breasts became gorged with milk. Mr. Dodd has given us authentic proofs of the facts of this case.

Dr. Paris says, in his "Medical Jurisprudence," that in 1816 and during the French Revolution girls were admitted to the Maternité at thirteen, and some even at eleven years of age.

In Oriental races, maternity at twelve years of age is not at all uncommon. In Persia, for example, girls marry at eleven or twelve, and soon become mothers.

The latest age of gestation has been a subject of keen contention. We may adopt the statement of Fordyce Barker.[1] He met with the case of a lady born May 5, 1801, who was delivered May 6, 1852, and again in July, 1853. He cites two other instances of women over fifty having become mothers. He says: "After the most careful and laborious research I can find but one authentic case, based on the evidence of a respectable medical man, who carefully investigated the documentary proof, where a woman who had reached the age of fifty-five years has given birth to a child. This case is recorded by Dr. Davies, of Hertford, England.[2] I feel warranted in stating the proposition that the laws of physiology, the experience of mankind, and the decisions of courts of law, justify a medical man in declaring that a woman over fifty-five years of age is past the period of childbearing."

A correlated question is: Whether a woman may conceive some months after the cessation of the catamenia? If it can be established that a woman who had been regular throughout had ceased to menstruate at the usual climacteric age, say forty-eight, the presumption is very strong that she is no longer capable of conceiving.

The physician is occasionally consulted as to the probability of pregnancy in women of a certain age, marriage depending upon his opinion. There are signs which aid in arriving at a decision. Putting aside all subjective signs, he examines the sexual organs. If the breasts have become shrunken, if the vagina is getting tense and contracted, if the uterus is smaller, lighter than in the stage of active function, if the vaginal portion is shortened, nearly flush with the vaginal roof, the os externum a small round hole, and the color of the mucous membrane yellowish pale, we may conclude that

[1] Philadelphia Medical Times, 1874. [2] London Medical Gazette, vol. 39.

the organs are in process of senile atrophy, and that pregnancy is, if not impossible, in the highest degree improbable.

The latest age is not to be decided by the subjective phenomenon of sexual passion. In many women this passion survives the capacity for conception. And many women who bear children never experience it.

The premature and protracted occurrence of menstruation have been respectively relied upon as evidence of capacity for reproduction. But it is necessary to avoid the error, now less frequent, indeed, than formerly, of confounding hemorrhages more or less periodical with true menstruation. The older books on forensic medicine teem with cases of menstruation in children and old women. These are to be regarded as almost invariably cases of hemorrhage from local or general disease. Hemorrhagic discharge continuing or appearing after the age of fifty is an indication for local examination.

THE CARE OF THE GRAVIDA.

The Hygiene of the Pregnant Woman.

To keep the process of gestation in its due physiological course, is a duty of the highest importance. Upon the fulfilment of this object depend not alone the present well-being of the woman during her gestation, and the safety of the fœtus, but also her riding safe through the perils of puerpery.

A healthy woman when pregnant has but few rules to observe. They may be stated as follows: (1) To keep the secretions in order; (2) to take regular exercise, in the open air when possible; (3) to avoid late hours; (4) carefully to avoid heated and foul atmosphere, as in badly ventilated houses or public buildings; (5) to take care that her habitation be clean as regards drainage and sewerage; (6) to be careful in diet, avoiding indigestible food and excess in stimulants; (7) to dress warmly, avoiding all tight lacing, and other tricks for "preserving the figure" at the cost of free play for the lungs, heart, and abdominal viscera. This condemnation extends to corsets which compress the breasts and nipples. Those women in whom the abdominal walls are lax may with advantage wear a well-devised belt so made as to support the abdomen and uterus from below.

This great principle should be borne steadily in mind, that, since the safe passage through the trials of puerpery depends mainly upon the effective working of the excretory system, all rational means, as exercise, baths, and other factors of health, for developing the functional capacity of the glandular system should be pursued.

During the first three months whilst the uterus is lodged in the pelvis, violent exertion should be avoided with special care. Retention of urine should be guarded against, and if frequent dribbling or dysuria occur, examination should be instituted.

It is desirable—although sometimes not within the power of the physician to carry out—(1) to examine the urine for albumen and sugar at frequent intervals, say once a week during the latter four months of gestation; (2) during the first three months to ascertain if the uterus is in due relation to the pelvic axis. This rule is imperative in the case of women known to have been subject to prolapsus and retroversion when not pregnant. (3) Opportunity should be taken to ascertain if the pelvis and soft parts be well formed and adapted for healthy labor. (4) In the last month it is especially desirable to ascertain if the position of the fœtus be normal, in order to rectify it before labor supervenes.

CHAPTER IX.

ABNORMAL GESTATIONS.

THE principal forms of abnormal gestation may be classified as follows:

A. Ectopic or extrauterine gestations.

B. Gestation in one horn of a two-horned uterus or other imperfectly developed uterus.

C. Uterine gestation complicated with tumors, uterine or extrauterine, or other abnormal conditions.

D. Superfœtation.

A. **Ectopic or Extrauterine Gestations.**—We first adopted[1] the term "ectopic" as more accurate than the old term "extrauterine." Some gestations, as those taking place in the lower segment and in the cervical canal of the uterus, and in the wall of the uterus, are abnormal and ectopic, but not strictly extrauterine.

The ovum may be arrested and fecundated at any point along its transit to the uterus. Thus we may have (1) ovarian, tubal, tubo-ovarian, abdominal, mural or interstitial gestation; (2) it may reach its normal nidus, the body of the uterus, constituting normal gestation; or (3) it may pass through the body of the uterus proper and be grafted upon the lower segment of the uterine cavity, constituting subectopic gestation—this is the condition that obtains in placenta prævia; or (4) it may even drop into the cervical canal and be developed there—this is strictly an ectopic gestation; and (5) a fifth variety consists in the development of the ovum in one horn of a two-horned uterus.

Extrauterine gestation is seen in the lower animals. Specimens are preserved in University College and in other museums.

1. Beginning with the seat of genesis of the ovum, we first have to consider OVARIAN GESTATION. The ovum failing to escape from the ovary is fecundated *in loco*, and the postulate is that there it is developed. The possibility of fecundation in or on the ovary can hardly be disputed, but the development in the ovary has been formally contested by Velpeau, Arthur Farre, and more lately by A. Willigk, who has minutely examined several alleged examples, and failed to find embryo or membranes in the ovary. On the other hand, Duverney, Goupil, P. U. Walter, Hecker, and Puech relate cases which it is difficult to reject. It is convenient to merge the history of ovarian gestation in that of the other forms.

2. TUBAL GESTATION.—The ovum may be arrested in any part of the Fallopian tube. A common part is the outer third, which presents more dilatation; sometimes it is arrested in the grasp of the fimbriæ, and sometimes near or in the *ostium uterinum*. When the arrest is within the fimbriæ the case is nearly akin to or may merge into the tubo-ovarian variety; when the arrest is near to or in the ostium uterinum the case is akin to or may merge into the mural or interstitial variety. The simple tubal gestation is perhaps the most common; it presents the most typical history.

The *causes* of arrest of the ovum are inflammatory adhesions of the tube (Hecker); obstruction of the ostium uterinum by polypi, or fibrous tumors

[1] Diseases of Women, 1878.

in the uterus (specimen in University College Museum); hard work has been frequently observed in this connection (Robert Barnes); twins have been observed many times, the two ova may obstruct each other (Robert Barnes). A remarkable fact has been frequently observed, namely, that the gestation takes place in the tube opposite to the ovary in which the corpus luteum is found. How is the passage of the ovum, say from the right ovary to the left tube, to be explained? There are two theories: *a*. That insisted upon by Oldham, the *extrauterine transmigration*, by which

FIG. 95.

GESTATION IN LEFT FALLOPIAN TUBE. THE SAC RUPTURED. UTERINE MUCOUS MEMBRANE DEVELOPED TO THICK DECIDUA.
St. Thomas's Museum. (Natural size.)

it is supposed that the ovum dropped from the right ovary, evading the grip of the right *morsus diaboli*, falls into the abdominal cavity, and is carried over by the movements of the intestines to the left tube, by which it is seized. The possibility of this migration seems proved by cases narrated by Rokitansky, Luschka, Schultz, and others in which the tube, corresponding to the ovary which yielded the ovum, was impervious. But the ovum frequently wanders to the opposite tube where both tubes are quite normal. Mr. Stirling, of the Edinburgh University, informed Robert Barnes (1875) that in eight out of twenty sheep the ovum was found in the opposite horn of the corpus luteum.

b. There is the hypothesis of *intrauterine transmigration*. Tyler Smith started the idea that the ovum received in its associated tube might travel along it, enter the uterus, cross over to the opposite ostium uterinum, and

thus get into the opposite tube and be developed there. That the ovum may wander in the uterine cavity is proved by cases of placenta prævia, and fluids may pass from the uterine cavity into the tubes. Klob, however, denies the possibility of intrauterine transmigration.

The *influence of extrauterine gestation upon the uterus* is remarkable. The uterine mucous membrane is developed into decidua. The nest is prepared, but the ovum does not come to occupy it. This decidual development is, as Velpeau pointed out, proportionate to the proximity of the gestation-sac. It is most marked in mural and tubal gestations; less so, or perhaps absent, in abdominal gestations. Most museums show examples. The figure (95), from a specimen in St. Thomas's Museum, illustrates this and other features.

The relations of the ovum to the mucous membrane of the tube differ in important points from those observed in uterine gestation. Oldham, Kiwisch, and Virchow showed that the tubal mucous membrane does not develop a true decidua. It is deficient in the utricular glands which the uterine membrane possesses. The chorion-villi are implanted directly upon the mucous membrane. Poppel says that, even if a decidua vera be formed, there is no serotina. Hennig says the placenta is developed on a different plan from that of the normal uterine placenta; it is developed according to the plan which governs the normal gestation in rabbits, cats, and dogs. This slender attachment may serve to explain the facility with which separation and hemorrhage take place. In like manner, and *à fortiori*, in abdominal gestation there is no decidua or proper representation of the maternal element of the placenta. The placenta is attached directly to the outer surface of the uterus or of some abdominal organ.

The Course of Tubal Gestation.—The ovum, arrested in the tube, develops its chorion into placenta, which adheres to, rather than penetrates, the tubal mucous membrane; growing, it distends the tubal wall, forming a gestation-sac; usually within three months—Hecker says in the great majority of cases within eight weeks—the stretching and growing capacity of the sac is exhausted, and the tube bursts. This bursting usually occurs at a menstrual epoch. There is, as Robert Barnes insisted, a close physiological analogy with placenta prævia and abortion. Hemorrhage from the uterus commonly precedes bursting. This premonitory hemorrhage, he explains, is due to the growth of the ovum exceeding the accommodating growth of the tubal sac; vessels get separated and yield blood. Some of the blood escapes by the uterus, some is retained in the tube, and, adding to the distention, leads to the rupture by producing spasmodic action of the muscular wall. The ovum itself does not always burst. The accumulated blood in the tube, together with fresh blood proceeding from the torn vessels, is now poured into the abdominal cavity, causing the shock and other phenomena which mark the climax.

The injury sustained is compound: there is the traumatic violence attending the rent, and the sudden impression upon the ganglionic centres producing shock and the hemorrhage. The symptoms are twofold: shock induces collapse, marked by coldness, prostration, near extinction of the pulse, vomiting; deadly pallor supervenes, and in a short time—a few hours perhaps—the patient may die. To this assemblage of symptoms, Robert Barnes gives the name "abdominal collapse." The suddenness and the character of these symptoms, quickly killing a woman who up to the catastrophe might have been in sound health, have often excited suspicion of foul play by poison or other violence. Hence the necessity for an autopsy. If the woman survives the shock, the symptoms of hemorrhage become manifest; the general signs are those of anæmia; the local signs may be the feeling of an accumulation of blood in Douglas's pouch, the "cataclysmic" form

of retrouterine hæmatocele. At this stage, again, the patient may sink under the combined effect of continuous shock and hemorrhage. If she survive this stage, she has still to encounter the third danger—that of peritonitis. This may set in rapidly. Intense pain continues, the abdomen swells, becomes tense, the pulse rapid and small, the temperature rises two or three degrees, and the countenance puts on the anxious drawn expression characteristic of abdominal injury. Still the case may end in recovery. How can we help to this end?

Treatment.—There are two distinct epochs in the history to be studied: (*a*) the stage of development of the gestation before rupture, with a view to the prevention of this catastrophe; (*b*) the stage after rupture. *a*. The treatment during the first stage must depend upon the *diagnosis*. A tubal gestation may be predicated from the presence of the usual subjective signs of gestation, added to which is pain—this, says Goupil, is constant; and the local objective signs. There is a swelling commonly seated behind the uterus, usually more on the left side. This is fluctuating, tense, pear-shaped or sausage-shaped, possibly movable; the uterus is always somewhat enlarged, and, as is the case whenever a tumor gets behind it from above, it is pushed downwards and forwards nearer to the symphysis pubis, often pressing on the bladder and causing retention of urine. This tumor has to be differentiated from small ovarian tumors, retroversion of the gravid womb, or retrouterine hæmatocele. Retention of urine is far less frequent during the development of a gestation-cyst than in any of the three cases specified. Retroversion may be distinguished by tracing the firm rounded body of the uterus by vaginal and rectal touch, and by the mass behind the cervix being much lower, nearer to the pelvic floor, than is at all common with a gestation-sac.

The ovarian cyst has probably given rise to more protracted symptoms: it does not cause suspension of menstruation; the uterus is not enlarged; the characteristic coloration of the vagina and the other signs of pregnancy will be wanting. Partly by a process of exclusion, partly by positive signs, we arrive at the presumptive, if not the absolute, conclusion that the case is one of tubal gestation. This settled, several methods of treatment offer themselves. The necessity for active treatment to arrest the growth of the embryo is emphatically stated by Lesouef, who affirms that every woman who has become the subject of an extrauterine gestation is doomed to more or less speedy death. The qualification of this sentence is certainly limited. *α*. The cyst may be tapped by an aspirator needle or trocar. The liquor amnii drained off, the cyst collapses, and the embryo perishes; atrophy of the cyst ensues. This has been successfully practised by Greenhalgh and E. Martin. *β*. Injections into the sac. Friedreich injected a solution of morphia with complete success. *γ*. Bacchetti proposed to kill the embryo by passing an electric shock through the cyst. Duchenne suggested the shock of a Leyden jar. Of these methods the simplest is the tapping the cyst by the aspirator needle. Indeed, it is probable that the puncture of the cyst, which forms a part of the other methods of operating, is by itself adequate to account for the successful results. *δ*. It has been proposed to arrest embryonic growth by agents introduced into the mother's blood. Iodine and starvation have been discussed. We may succeed in iodizing or starving the patient, but the desired effect upon the embryo cannot be counted upon. *ε*. The sac may be cut down upon, ligated, and removed.

b. Then comes the question what to do when rupture has taken place. There is a growing consensus of opinion in favor of performing *laparotomy*, seeking out the sac, tying the tube on the uterine side, and excising the sac. By this proceeding the risk of further hemorrhage is avoided, and the

abdominal cavity can be cleansed of effused blood and clots, thus lessening the risk of peritonitis. This operation does not materially add to the shock already dealt by the rupture, and it gives the best chance of recovery in severe cases. It must, however, be borne in mind that the first shock and hemorrhage may be fatal. Our judgment is decidedly in favor of the operation. It should be done early.

c. There is still a third stage requiring treatment. It is that when the period of shock has passed, when the blood effused is segregated as hæmatocele by peritonitic effusion. This is often attended by irritative fever. The uterus is set fast, pressed downwards, and a mass is felt behind, sometimes more prominent in the seat of one broad ligament. Sometimes the retro-uterine mass is firm, nodular; sometimes soft, semifluctuating. In the latter case especially it may be useful to tap by the aspirator-trocar, and to insert a drainage-tube to let the liquid blood or pus run off. For this purpose a special trocar and canula, longer than those usually supplied with Dieulafoy's apparatus, are required. Through this, on withdrawing the trocar, a wire drainage-tube is run into the sac before the tube is withdrawn. Even in this case it may still be the wiser course to open the abdomen, and remove the offending structures.

The general treatment is indicated by the constitutional reactions. Pain may be allayed by subcutaneous injections of morphia, by cataplasms, hot fomentations, and suppositories of opium. Collapse must be combated by stimulants, of which the most efficient is the subcutaneous injection of a drachm of pure ether. In the suppurative stage quinine is most useful.

3. TUBO-OVARIAN GESTATION occurs when the ovum is contained in a sac formed between the fimbriated end of the tube and the surface of the ovary. It is less likely to end in rupture than the tubal form. It is prone to go on to the full development of the fœtus. What then happens resembles the course of the next form.

4. ABDOMINAL GESTATION.—It appears to us doubtful whether this form is ever primary; that is, whether the ovum attaches itself *ab initio* to some spot of the peritoneum. It is true that ova, impregnated or not, may escape the *morsus diaboli*, and fall into the abdominal cavity, there to perish; and Kiwisch insists that spermatozoa also stray into the peritoneum, there to meet the stray ovum. Such a fortuitous concourse of atoms rests upon conjecture. Probably abdominal gestation is always secondary upon tubal or ovarian gestation. Inflammatory adhesions form with the peritoneum, and the sac is enlarged. The course of an abdominal gestation is prolonged. Intercurrent attacks of pain, the expression probably of attacks of peritonitis, occur. The cyst may burst, but this is rare. The fœtus arrives at maturity and dies. An abortive labor occurs. Under the exhaustion of this effort the woman may sink. Peritonitis proceeding from rupture or perforation of the sac, preceding or following the death of the fœtus, may prove fatal. In one case of this kind narrated by Robert Barnes, a fluctuating swelling formed behind the uterus. Perforation may take place into intestine or bladder, into the vaginal roof or rectum, or even through the abdominal wall. In these cases the fœtus, decomposed, broken up, may be discharged piecemeal, partially or wholly through fistulous openings. This is a tedious process; hectic and emaciation may after weeks or months exhaust the patient. The diagnosis is often difficult. Almost all the cases in which this form of gestation was suspected which have come under our observation turned out to be ovarian cysts. The confusion does not entail injury to the patient, since the course to be adopted is the same in either case. The *treatment* is to open the abdomen for exploration where doubt exists. An ovarian tumor will of course be removed. If the case turn out to be a

gestation-cyst the cyst is laid open, the fœtus is extracted, and the placenta is left with the cord hanging out of the abdominal wound, which is then closed. After a time the placenta is detached, breaks up, and comes away whole or in débris. In cases where fistulous openings are formed into the rectum or through the abdominal walls, these should be enlarged, and fœtal débris extracted; discharges should be evacuated by drainage-tubes, and antiseptic irrigation should be practised.

There are three successive epochs at which laparotomy may be practised: (1) during the development of the embryo; (2) when the natural term of gestation is accomplished; and (3) after the death of the fœtus. During the first stage the embryo or fœtus may be killed by Duchenne's plan of shock by a Leyden jar. The sac may be punctured; but in a case where this was practised by Hicks the patient died of hemorrhage. Upon the whole, expectancy is perhaps the wisest course until the second stage is reached. Then new dangers arise, the cyst may burst, hemorrhage and peritonitis may set in. Levret, Gardien, Velpeau, Kiwisch, Koeberlé, and most recent authorities advise laparotomy. It offers the best chance. Koeberlé cites nine cases, seven children and four mothers being saved. Meadows related a good case to the Obstetrical Society (Nov. 1883). In the third stage, when tolerance has been attained, the operation is still advisable. The process of calcification is hardly to be trusted; and when all vital action is

FIG. 96.

TUBOUTERINE; INTERSTITIAL OR MURAL GESTATION. (After POPPEL.)

a. Cavity of uterus clothed with decidua. *b*. Broad ligament. *c*. Tubouterine sac which contained embryo. *d, d*. Thicker part of cyst-walls. *e*. Placenta.

at an end by the death of the fœtus, opening the sac is hardly more dangerous than opening an abscess. Hutchinson and others prefer this, the so-called secondary operation.

In some cases tolerance of the abdominal gestation-sac is established. The dead fœtus becomes compressed, the liquor amnii being absorbed. Then a process of calcification of the sac and membranes takes place, and the fœtus

is shut up as it were in a calcareous shell as an inert mass. In this way women have lived many years, dying ultimately of old age. There is a remarkable specimen sent by R. W. Watkins to Robert Barnes, and by him described in the "Obst. Trans.," vol. viii., and presented to St. Thomas's Museum. This fœtus had been retained forty-three years. Sappey recently communicated to the Academy of Sciences, Paris, a case in which a well-formed fœtus, enclosed in a calcareous case, was found *post mortem* in Douglas's pouch. It had been diagnosed fifty-six years previously. The fœtus in such a case is usually called a "lithopædion," it being supposed that it undergoes a calcareous transformation. But Robert Barnes, from a minute examination of Watkins's and other specimens (see memoir on "Missed Labor," "Obst. Trans.," 1881), has shown that the calcification is limited to the membranes and sac, the shell thus formed preserving the fœtal structures but little changed.

5. Parietal (Ramsbotham), Mural, Interstitial, or Tubouterine Gestation.—In this form the fecundated ovum is developed in the uterine portion of the tube. Such cases are relatively rare, and for the most part the gestation-sac encroaches upon the free part of the tube. Hence the term tubouterine. These gestation-sacs burst early. The diagnosis from tubal gestation is difficult. The uterus may be expected to be enlarged, as being more implicated. Several presumed cases of parietal gestation have been proved on minute examination to be really examples of gestation in a rudimentary uterine horn. The issue is commonly fatal. Some cases of supposed "missed labor" were probably ectopic gestations of this variety. And some cases presumed to be mural more strictly belong to the next order.

6. Gestation in One Horn of a Two-horned Uterus, or in the Horn of a Single-horned Uterus.—Luschka, Kussmaul, and others

Fig. 97.

Gestation in a rudimentary horn of uterus. (After Luschka.)

A. Developed right horn. B. Rudimentary horn, with a rent through which the embryo had escaped. 1. Right Fallopian tube. 2. Left Fallopian tube. 3. Left ovary. 4, 5. Right ovary and corpus luteum. 6. Round ligament.

have demonstrated the characters of these forms of gestation. In cases in which the horns of the uterus or one of them persist in a rudimentary form, not being completely fused into one uterine body, an ovum may be developed in a horn never reaching the imperfect uterine body. Thirteen cases

collected by Kussmaul all terminated by rupture of the fruit-sac and death. Professor Turner has thrown additional light upon this variety.[1]

7. Retrouterine Gestation.—It deserves to be noted that extrauterine gestation-sacs generally find accommodation, at least in part, in Douglas's pouch. Here they may often be felt and diagnosed, and offer facilities for treatment. They may be punctured through the vaginal roof, liquor amnii drawn off, and fœtal bones may be extracted by this route. Forming a tumor behind the uterus they may obstruct the entry of an intrauterine fœtus into the pelvis. Fig. 98 (from a beautiful specimen in St. Thomas's Museum) shows well the fruit-sac between the uterus and rectum, and other relations.

8. Hernial Gestation.—Still another variety of ectopic gestation remains to be noticed. *Hernia of the gravid uterus* cannot indeed strictly be classed under extrauterine gestation. The gravid uterus has been found in

Fig. 98.

RETROUTERINE GESTATION.

B. Intestines. U. Uterus. V. Vagina. R. Rectum.
The fruit-sac between uterus and rectum laid down, showing fœtus.

a hernial inguinal sac. Here it is the uterus which is ectopic, not the gestation. The case will be found described along with the "Displacements of the Gravid Womb."

Subectopic Gestation may be said to occur (α) when the ovum is implanted upon, and grows in the lower zone of the uterine cavity, below Bandl's ring (Robert Barnes). This is the condition marked by "placenta prævia." It will be described under "Hemorrhage."

(β) When the ovum is developed in the canal of the cervix uteri. Cha-

[1] Malformations of the Organs of Generation, Edinb., 1866.

vanne narrates a case. It is extremely rare. Below this point there seems no hold for the ovum. We are not acquainted with an instance of gestation in the vagina.

APPARENT GESTATIONS.—*Dermoid cysts* in some respects simulate gestation.

The *fœtus in fœtu* presents a stronger resemblance to gestation. One embryo may be included in another. The *ovum in ovo*, described and figured by Robert Barnes ("Obs. Trans.," vol. iv.), is a typical example of this phenomenon in the fowl. A remarkable fact in this case is that the shells of the two eggs always differed in color. The inner shell was reddish, like the Cochin fowl's and the partridge's, the outer shell dull chalky-white. The hen was a half-breed between the Cochin and Dorking. There are specimens of one complete ovum and shell inside another in the College of Surgeons. Analogous examples are known in man. In the museum at Munich we saw a remarkable specimen, the skeleton of an adult man whose thorax includes a developed fœtus. The subject had served in the army. Other examples are figured in Förster and Ahlfeld.

C. Uterine Gestation may be complicated with—

1. An ectopic gestation, especially the abdominal variety.
2. Ovarian cystic tumor, or dermoid cyst.
3. Enlarged liver.
4. Cystic disease of the kidney.
5. Pelvic hæmatocele.
6. Ascites.
7. Uterine tumors.
8. Cancer of uterus.

1. COMPLICATION OF UTERINE WITH EXTRAUTERINE GESTATION is rare; but several cases are recorded. The uterine gestation may go on to term, and the ectopic gestation may be undisturbed. Indeed, an ectopic gestation may persist through several recurrent uterine gestations. But the danger is serious—first, of premature expulsion of the uterine fœtus, from impediment to the due development of the uterus; second, of rupture of the uterus under labor at term from the ectopic gestation-sac blocking the entrance to the pelvis; third, from inflammation being set up in the sac or neighboring structures under the pressure of the growing uterus or the violence during labor.

2. COMPLICATION WITH OVARIAN TUMOR.—The history offers points of great clinical importance: (*α*) the gestation may go on to term, and labor takes place naturally; we have known cases of several successive gestations run their course; (*β*) the case may end in abortion or premature labor; (*γ*) the term of gestation attained, the uterus may rupture from obstruction to the labor, the tumor getting in the way; (*δ*) the ovarian cyst may burst under the rapid double growth of uterus and tumor, shock and peritonitis may ensue and prove fatal; (*ε*) the cyst lifted up by the growing uterus may be rotated on its axis, twisting its pedicle, strangulating its vessels, leading to necrosis and death by exhaustion and peritonitis. Robert Barnes records two examples of this termination.

The dangers then are very great. In no given case can we feel secure that one of the catastrophes specified may not occur, and that at any moment without warning. This consideration compels us to adopt a decided measure to put an end to the complication.

The *diagnosis* is difficult. The first point is to verify the existence of uterine pregnancy. The positive objective signs will establish this element in the case. The next points to determine are that there is a complicating tumor and the nature of it. Assuming the extreme difficulty of determining

whether the complicating tumor be an ectopic gestation or an ovarian tumor, we must generally be content with the conclusion that it is one or the other. The common features are, (*a*) the abdominal enlargement is greater than the estimated stage of uterine pregnancy will account for; (*β*) the shape of the abdomen is different, it is stretched out on either side, the two swellings, more or less spherical, leave a sulcus between them at the point of divergence above. This obtains to some degree in the case of uterine twin-gestation, but in this case we ought to hear two fœtal hearts, and in the case of the complication under discussion, the uterus will be pushed to one side, so that the fœtal heart and the other proper uterine characters, as peristaltic movements, will be made out in an iliac region or a flank, and generally nearer the pelvis than usual; (*γ*) the ectopic gestation-sac commonly projects more or less behind the uterus in Douglas's sac, where it may be felt.

The above rules apply merely to the ovarian cyst. In this latter case an area of fluctuation may be made out. But this is not constant.

Treatment.—The system will hardly tolerate the concurrent progress of two growing tumors, as of uterine gestation and ovarian cyst. The process of accommodation might keep pace with one, but it is unequal to the double strain, mechanical and constitutional. Something must give way. It is an urgent case for the intervention of art. Upon which factor shall we operate? The uterus or the tumor? The readiest course is to act upon the uterus by inducing abortion. The case is thus reduced to its simplest expression. But the measure is unsatisfactory. The ovarian tumor goes on unchecked, and we know that its natural tendency is to kill at no remote period. Very little then is gained. Nor is the proceeding free from immediate danger. The puerperal process may be disordered. And another consideration is important. If we induce abortion the offspring is necessarily sacrificed, and if we wait for the period of viability we are running all the risks attendant upon the complication. On the other hand, if we act upon the tumor by extirpating it, the morbid element of the complication is removed, the uterus is left free to its natural development, and the child may be born alive at term. It may be apprehended that ovariotomy during gestation would provoke abortion. Experience has solved this question. The operation has been successfully performed under these circumstances several times.

An alternative is tapping the tumor. Under exceptional circumstances forbidding ovariotomy, this may be practised. But it can at best afford temporary relief. It cannot be regarded as a substitute for the complete operation.

The tumor then should, as a rule, be removed. There should be no hesitation or delay; (*a*) if the tumor is growing rapidly; (*β*) if there is increasing distress in the circulation and respiration; (*γ*) if the cyst is multilocular, colloid, or dermoid; (*δ*) if it become inflamed suppurated, or twisted; (*ε*) if peritonitis or severe prostration suggesting rupture of the cyst occur. It is better to operate as early in the gestation as possible.

Like reasoning and practice will apply to the case of ectopic gestation.

We find twelve recorded cases in which the ovarian tumor has been removed during pregnancy. Nine of these are by Spencer Wells; five went on to term, mother and child surviving; in one case the fœtus was removed at the same time; in two abortion followed, one mother dying; in one case operated upon at seven months, the child was born alive twenty-five days after, the mother recovered. In Tait's case abortion and death followed. In Baum's case abortion followed; the mother recovered. In Galabin's case the woman went to term, a live child was born; the woman recovered after an attack of phlegmasia dolens.

3. Gestation with Enlarged Liver.—In this complication the growth of the gravid uterus is impeded. Abdominal distention leads to gastric disturbance and distress of the thoracic organs. The *diagnosis* is established by (α) previous knowledge of the liver disease; (β) dulness on percussion extending from the costal cartilages downwards; in the early stage of gestation an area of resonance will be left between the liver above and the uterus below; later on this resonant zone will disappear; (γ) the positive evidences of gestation. The enlargement of the liver may be solid or cystic from hydatids.

Abortion may occur spontaneously. If not, the question will arise as to the induction of labor, and the best time for taking this step. This must be determined by the urgency of the symptoms. But, as a general rule, bearing in mind the pernicious effect of gestation upon liver and kidney disease, the elimination of the pregnancy should not be delayed too long.

In the case of hydatid cyst, the aspirator-trocar should be used to tap the cyst, before acting upon the uterus.

4. Gestation with Cystic Disease of the Kidney.—Similar distress from distention may arise. Here again an area of dulness will be traced from above downwards to meet the dulness of the ascending gravid uterus; an area of resonance is made out between the cyst and the uterus until they meet. Fluctuation in the cyst will probably be evident. The first course to discuss will be the expediency of tapping the cyst. The next will be the question of inducing abortion.

5. Gestation with Pelvic Hæmatocele.—This complication is rare, but we have met with it. Unless symptoms lead to digital examination, the existence of the hæmatocele may not be suspected. If the tumor encroach much upon the pelvis, the question of inducing labor will arise. The diagnosis will clash with that of ectopic gestation.

Gestation may be complicated with other abdominal tumors, as hydatids of the intestines, malignant and other tumors of the omentum.

6. Gestation with Ascites.—This complication is most likely to arise in association with albuminuria. It is rare. If the fluid in the peritoneum be in large quantity, and the gravid uterus small, the gestation may be masked, and we may have to depend for diagnosis partly upon the subjective history. If the dropsy depend upon heart disease or liver disease, it will probably have been of a duration antecedent to the computed pregnancy. The treatment will be governed: (1) by the urgency of the symptoms due to pressure; (2) by the disease to which the ascites is due. We may be called upon to act upon the uterus by inducing abortion, or to tap to relieve the ascites. The best plan of tapping is by help of Southey's drainage-needles. Special treatment will be directed to the causative disease.

7. Gestation with Uterine Tumors.—The relation of fibroids to the gravidity will vary according to the size, position, and other characters of the tumor. We have in this place to refer briefly to the bearing upon gestation. The greater clinical interest centres upon the relations to labor and puerpery. The characters of the tumors present great variety. It may be stated generally: (α) that tumors projecting from the external wall of the uterus are the most harmless; they may not disturb the gestation or the labor; (β) tumors growing in the wall of the uterus may interfere with the easy development of the uterus, and thus provoke uterine spasm, perhaps hemorrhage and abortion; they may even lead to laceration of the uterine wall; they partake in the developmental growth of the uterus, and may thus take on rapid enlargement, causing severe pain; (γ) tumors projecting into the cavity of the uterus also grow under the stimulus of gestation, and are

likely to lead to hemorrhage, pain, and abortion; (δ) tumors growing at the fundus, or upper part of the uterus above the ovum, are least harmful, whilst those growing in the lower segment below Bandl's ring are especially dangerous during gestation, and still more during labor.

In foresight of the great dangers that gather during labor at term and puerpery, it will generally be an anxious question whether abortion or premature labor should not be induced. It is difficult to lay down specific rules. Each case must be treated according to its peculiarities. But when the tumor occupies the lower segment of the uterus or the cervix, it will rarely be justifiable to let the gestation proceed. Sometimes a still more serious course must be adopted. Tumors enlarging under gestation may lead to impaction in the pelvis, and by eccentric pressure endanger life by pressure on the bladder and other pelvic structures, or by undergoing necrosis. In such a case, ablation of the entire organ must be performed by laparotomy. Such a case is narrated by Robert Barnes.[1]

Fortunately, in a large proportion of cases of fibroid tumors, the uterus is so deformed and its functions so disturbed that impregnation is prevented; and in other cases, if conception takes place, it is cut short by early abortion. The question is often put to the physician, Should women bearing uterine tumors be forbidden to marry or to run the risk of pregnancy? The advice dictated by prudence and experience will almost invariably be: Accept celibacy and sterility. To graft a parasitic being, as an ovum may be regarded, upon a uterus unfitted to bear it, will too frequently be to court danger and death.

8. Gestation with Cancer of the Uterus.—The dangers attending this complication grow with the advance of pregnancy. In one or two rare instances, the reality of which is open to dispute, pregnancy has seemed to cause the necrosis of the diseased mass, and thus to produce a cure.[2] The common seat of the disease is the cervix uteri, therefore exactly in the line of transit of the ovum in abortion and labor. At the same time the body of the uterus, the true nidus of the ovum, may be unaffected. It will keep pace with the development of the embryo, and the gestation is more likely to go on to term than in the case of fibroid tumors. Discharges, aqueous and hemorrhagic, will occur, and sometimes septicæmia from absorption of the foul discharges; but this is not common during gestation. It is doubtful how far the progress of the disease is affected by the gestation.

The diagnosis is generally, but not always, easy. An irregular lobed condition of the vaginal portion with shot-like knobs from obstructed or inflamed glandules, combined with the great turgidity and occasional abrasion of the cervical epithelium proper to gestation, may simulate epithelioma.

The questions arising are complicated. The life of the mother, whether the gestation be allowed to go on or not, is almost equally compromised; so that the question of saving the child assumes greater relative importance.

The questions to be discussed are: α. The complication being recognized early, can anything be gained by inducing abortion? The answer will be in the negative. The embryo, of course, is sacrificed, and the mother's condition will not be improved. β. Can we treat the disease with any advantage, leaving the pregnancy to go on? Two plans are offered: (a) In some cases the greater part of the diseased structure may be removed by the wire écraseur and cautery. In this way we have operated upon a woman in two successive pregnancies, securing her from hemorrhage, and so improving the condition of the cervix that live children were delivered, the mother hardly

[1] St. George's Hospital Reports, 1877, and Diseases of Women, 2d ed.
[2] Newman's case, Obstet. Trans., 1867.

suffering more than under ordinary circumstances. (*b*) Another course is to carry out Freund's operation of removing the entire uterus, and with it the disease. If the uterus is still free, so that the whole of the disease can be removed, this is the course to be preferred; and this, whatever be the stage of the gestation. The operation has been successfully performed by Spencer Wells.[1] If the disease has invaded the neighboring structures fixing the uterus, the operation is not available, (*c*) and we have to weigh the questions of provoking labor, so as to lessen the injury to the diseased structures that must occur at the birth of a full-sized child, and, if that is not available, of performing Cæsarean section.

The presence of malignant disease is unfavorable to fecundation. In many cases, probably, the condition discourages sexual intercourse; where this is practised, the discharges will tend to prevent fecundation. Still, unhappily, the complication is not rare.

[1] Medico-Chir. Trans., 1882.

CHAPTER X.

DISPLACEMENTS OF THE GRAVID UTERUS—RETROFLEXION—PROLAPSUS—PROCIDENTIA AND HYPERTROPHIC ELONGATION OF THE CERVIX—ANTEVERSION AND ANTEFLEXION.

The Displacements of the Gravid Uterus.

THE gravid womb may suffer all the dislocations and flexions to which the non-gravid womb is liable.

A dislocation of the uterus exists when it has shifted from its normal relations to the surrounding structures. Dislocation is another word for ectopy. A flexion of the uterus exists when its normal axis undergoes deviation.

There is a normal position of the uterus proper to each stage of gestation—that is, the position undergoes a progressive change as the uterus is developed (see Figs. 90 and 91).

These normal positions have been described under the head of "Diagnosis of Gestation." They must be carefully borne in mind when discussing the question of ectopy, especially during the first trimestrium.

In a less conspicuous degree the axis of the uterus also changes with its development. The general change is towards straightening. The axis of the body at first forms a curve with the axis of the cervix, concavity forwards; as gestation advances, the axis of the body and that of the cervix tend to merge into one straight line.

The dislocations of the gravid uterus are: retroversion and prolapsus, commonly coexisting—that is, either almost necessarily entails the other; anteversion, upward displacement, and displacement to one or other side.

The flexions are: anteflexion and retroflexion. Retroflexion often complicates retroversion and prolapsus. Retroflexion, pure and simple, of the gravid uterus can hardly exist. There may be complete procidentia. Retroversion and retroflexion are illustrated in Figs. 99, 100.

Retroversion of the Gravid Uterus.

The history of the subject is well given by Ramsbotham. Clinical observations of several older authors show that retroversion and its consequences had been recognized by them. But it appears that Grégoire was about the first to describe it definitely. William Hunter and Smellie, both pupils of Grégoire, made it known in England. Hunter figured it from an observed case.

1. *Retroversion* is the most serious form of ectopy. It is *complete* when the whole uterus is contained within the cavity of the pelvis; this may for clinical convenience be called "pelvic gestation;" *incomplete* when part is contained in the pelvic and part rises into the abdominal cavity.

Hence complete retroversion is almost exclusively limited to the first three or four months of gestation.

Frequency.—Retroversion of the gravid womb causing serious symptoms is comparatively rare. Dubois and Depaul hardly observed twenty cases

between them. In our experience it is much more common. As many as twenty or more have been admitted into St. George's Hospital alone. And retroversions not leading to serious complication—that is, cases in which relief is brought either by spontaneous abortion or by the rise of the uterus out of the pelvis, are certainly common.

The Clinical History and Symptoms.—The symptoms are *subjective* and *objective*. Subjective symptoms lead the patient to seek advice; then the objective symptoms come into evidence. During the first two months the patient may experience no serious distress, although the condition is gradually, *pari passu* with the development of the uterus, proceeding to a climax, which, by the end of the third month, or soon afterwards, declares itself quickly, in some cases almost suddenly, by intense suffering. But in most cases, women who are accustomed to take note of their feelings experience in an aggravated degree the symptoms that attend retroversion in the non-gravid state. The *pelvic signs* are: a sense of bearing down at stool, fatigue on walking, standing, or other exertion, with lumbo-sacral pain—"backache;" irritability of the bladder, frequent micturition, occasional difficulty in voiding the bladder, even passing attacks of retention. The *general signs* are: fatigue, malaise, disturbed digestion. At length, perhaps after some unusual exertion, as long walking, lifting weights, stooping and straining, the woman finds that she cannot pass the urine, and agonizing hypogastric and pelvic pain sets in; not seldom vomiting ensues.

Later on, the stage of impaction, locking, or incarceration arrives; the *subjective symptoms* are still more urgent. They are—(1) those of pressure, with severe pelvic and abdominal pain; (2) shock, the result of pain, interruption of the bowel and bladder functions, and the local violence caused by the displaced uterus; (3) reflex phenomena, straining or bearing-down, from the distended bladder and pressure of the fundus uteri upon the rectum; (4) secondary or constitutional symptoms, as urinæmia and exhaustion, and sometimes albuminuria; (5) numbness of the legs, from pressure on the sacral nerves.

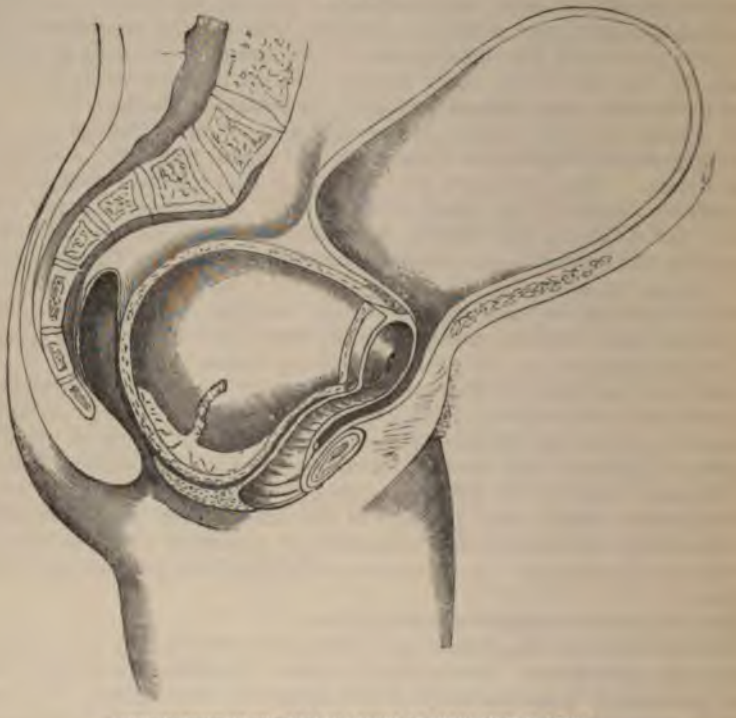
The sufferer is compelled to seek advice.

The *objective signs* discovered are: first, those made out by abdominal palpation and percussion. This brings out pain. The abdomen is found larger, more prominent than the stage of gestation will account for. The area of dulness mapped out extends from the pelvis below to either flank, and frequently higher than the umbilicus. The sensation is that of great renitent or elastic tension.

The shape of the projecting abdomen differs from that produced by the gravid uterus. It is more pointed. This is due to the distention of the bladder. Yet in answer to questions *ad hoc*, the patient and her attendants may declare that "she is constantly passing water." So far from leading the physician to accept this tale as evidence that the bladder is relieved, he ought to take it as strong presumptive proof that there is retention. There is no clinical aphorism truer than this: "Dribbling of urine is proof of retention." The bladder struggling spasmodically to overcome the obstruction at the urethra, and further compressed by the abdominal muscles thrown into spasmodic reflex contractions, gets partial relief by driving a little urine through the urethra. If this did not take place, liquid being incompressible, the bladder must quickly burst. Now this accident is very rare. In any case it is a wholesome rule to pass the catheter. This proceeding is at once diagnostic and remedial. If an unusual quantity of urine—say forty to sixty ounces—is drawn off, sensible relief is obtained; the abdominal distention and projection fall, the abdominal walls become comparatively flaccid, permit freer palpation. The hand may sink down and feel the spinal column,

giving evidence that the tumor was not due to morbid growth or the gravid uterus. Search is then pursued by the vagina. The finger, instead of finding its way backward and upward as usual towards the sacral hollow and promontory to find the cervix uteri, is directed by the peculiar deviation of the course of the vagina upwards and forwards to the symphysis pubis, and the

FIG. 99.



RETROVERSION OF THE GRAVID UTERUS AT THREE MONTHS ABOUT.

The cervix rises above symphysis, drags up and compresses urethra, causes retention and distention of bladder, and forward deviation of the vagina.

cervix and os uteri are found close against the symphysis, or even lifted up above it, so as to be difficult to reach (see Fig. 99). The sacral hollow, in fact, is blocked by a firm rounded mass which projects the posterior wall of the vagina forwards. This mass is the body of the uterus which, fallen back, rolled over on its transverse axis, has thrown the cervix up and forward. The relation of the uterine axis to the pelvic axis is reversed. In vulgar phrase, the uterus is capsized. This is shown in Fig. 99.

The uterus rolls over on its transverse axis, the fundus descending, the cervix ascending. The ascending cervix uteri drags up the attached base of the bladder, and this in turn drags up the urethra, so that the meatus is commonly pulled up behind the symphysis, so as not always to be easily found. At the same time the base of the bladder and the urethra are compressed against the symphysis. Hence obstruction and retention of urine. Posteriorly other objective signs appear. The enlarged body of the uterus, driven down by the spasmodic reflex expulsive efforts, causes perineal projection or bulging. Sometimes this sign is not conspicuous, but in others

it is very prominent. Halbertsma relates a case in which the fundus uteri actually opened the anus and partly protruded through it.

Diagnosis.—Almost all the subjective and objective signs described as belonging to retroversion may be produced by other causes. Thus: a small ovarian tumor, an ectopic gestation-cyst, a fibroid tumor of the posterior wall of the uterus, a retrouterine hæmatocele or abscess; an accumulation of fecal matter in the rectum; anything, in short, getting into Douglas's pouch may push the uterus bodily forward against the symphysis, and cause retention of urine. It must be borne in mind that up to this point we have been restricted to abdominal palpation and touch by vagina and rectum. We can at best take cognizance only of the physical condition of the parts as felt from below.

We now proceed in our exploration. The problem is to determine the nature of the rounded mass in the sacral hollow. There are differentiating signs that will rarely fail to lead to a safe clinical conclusion. First. As a general rule, *bodies getting into Douglas's pouch come from above the uterus, and so press the uterus downwards as well as forwards against the symphysis.* Thus the vaginal portion and os uteri will, when the displacement is produced by bodies external to the uterus, be found low down near the vulva, and pointing downwards. The meatus urinarius is not drawn up, as is the case in retroversion. These conditions are enough to distinguish the case from retroversion of the gravid uterus. But commonly, by rectal examination, and combined vaginal and abdominal touch, the uterus may be ascertained to preserve its normal axis, the fundus pointing over the symphysis, in line with the vaginal portion. Of course, the sound passed into the uterus would make this relation quite clear, and the uterus thus defined, the mass felt behind the vaginal portion is proved by the process of exclusion to be something else—that is, one of the retrouterine bodies enumerated above. But the probability of gestation precludes the use of the sound at present.

But without recourse to the sound we may conclude that, when the os uteri points downwards, and is carried low down near the pubic arch, the case is not retroversion. It remains to differentiate *retroflexion* from the cases in which the uterus is driven bodily downwards and forwards by something behind it. There are two signs that help. First, retroflexion of the gravid uterus is almost invariably attended by retroversion; the rolling over and descent of the body of the uterus will carry the cervix and os upwards, dragging the urethra and meatus as well. Thus, although the os may point downwards, it will be high up, perhaps on a level with or above the upper border of the symphysis, and hard to reach. Secondly, palpation above the symphysis may trace the cervix back into continuity with the body of the uterus. And, if the sound be used, it will not pass more than an inch beyond the os. The condition we have known to be most frequently mistaken for retroversion is retrouterine hæmatocele.

In both cases of retroversion and retroflexion the test of reposition or reduction comes into operation.

History, again—most treacherous of guides—may help. If there is clear evidence of regular menstruation, pregnancy may be excluded, and the sound may be used.

The causes of retroversion and retroflexion form an intimate part of the history. Denman, Dubois, Jacquemier, even Ramsbotham and later authorities, attributed the accident almost exclusively to distended bladder. The error of this doctrine was demonstrated by Tyler Smith,[1] who urged that retroversion of the gravid womb was simply a continuing condition

[1] Obstetrical Transactions, vol. ii.

from retroversion existing before gravidity. We think that, as a general rule, this is satisfactorily proved. We ourselves have traced the continuity in several cases. On the other hand, it is true that in some cases the dislocation may be produced suddenly under the pressure of the intestines upon the fundus uteri during severe effort in the stooping posture, as in lifting heavy weights, and a full bladder may under such effort contribute to the displacement. The cases resulting from prægravid retroversion may be distinguished as of *gradual development*. The growing uterus in its eccentric enlargement occupies more and more space, and at last compressing the surrounding soft parts against the unyielding walls of the pelvis, in which it is locked, the pressure-symptoms arise. Behind, the rectum is compressed, leading to constipation, sometimes to tenesmus and dysenteric symptoms. When the fundus comes down near the anus, reflex irritation ensues, straining efforts follow; the sacral plexus pressed upon, cramps and pains are felt down the thighs; the bladder drawn up, the urethra compressed, retention of urine and distention of the bladder quickly follow. This is another source of reflex irritation, and violent efforts to void the urine are added to the effort of defecation. Thus we see that the retention of urine and distention of the bladder are consecutive upon, not causative of, the displacement of the uterus. It is the old story of *τὸ ὕστερον πρότερον*.

When dislocation is produced, *ab origine*, under the direct influence of straining or pressure, the case may be called *acute retroversion*. The large uterus filling the pelvis, locked in it, equally compresses the urethra and causes retention. So in this case, as in that of gradual rise, the retention of urine is the consequence, not the cause. It is doubtful whether distention of the bladder simply is ever an adequate cause of retroversion. When the uterus is pushed forward by a body from behind, the retention is clearly due to the external pressure. The presumption is strong that the retention found associated with retroversion is equally due to pressure.

An analogous cause is vomiting. This may lead to acute retroversion.

A sudden fall upon the back may cause retroversion. This was the case in a woman brought to St. George's Hospital.

Retroversion may result from a fibroid outgrowth from the posterior wall of the uterus. The mass getting fixed under the promontory of the sacrum, the lower part of the uterus rises as gestation proceeds, until at length the eccentric pressure obstructs the bladder and the bowel. In one case of this kind we were compelled to remove the whole organ. The compression to which the uterus was subjected led to gangrene. The case is described in the "Diseases of Women." The preparation is in St. George's Museum.

An ovarian or fibroid tumor may prevent the uterus from rising out of the pelvis.

Another cause of retroversion is from the posterior wall of the uterus being bound down by adhesions. Most commonly, we believe, adhesions existing before gestation are in great measure atrophied or absorbed under the stretching produced by the growing organ. But sometimes adhesions may hold the fundus uteri back under the promontory; then, the lower segment of the uterus rising under the development of gestation, retroversion is produced. Blundell relates a remarkable case. A young lady ruptured an ovarian cyst when single, conceived when married, had retroversion of the gravid uterus irreducible from old adhesions, and died.

Narrowing of the pelvis, especially a too-jutting promontory, has been noted (Bailly, Callisen, Boivin) as a predisposing cause. It is obvious that in such a case the fundus in its rise, impinging under the over-arching promontory, may easily be directed backwards.

Incomplete Retroversion or Retroflexion.—It often happens that retroversion

of the gravid womb tends to spontaneous cure. It is usually imagined that this is effected by the uterus suddenly or gradually liberating itself, as it enlarges, from the pelvic cavity. It is true that in most cases this occurs. In some instances, however, the train of events is as follows: Up to the end of the third or fourth month of pregnancy there is pelvic gestation, with retroversion or retroflexion. At this stage the effects of eccentric pressure upon the pelvic contents are often felt; they may, however, gradually subside, and yet, on examination by the vagina, a retroflexion or a retroversion is discovered. What is the explanation of the disappearance of the symptoms? The ovum has continued to grow, and a pouch-like diverticulum has formed from the upper surface of the uterine walls. This as it enlarges receives the greater bulk of the fœtus, and so at last only a lesser pouch containing a lesser portion of the fœtus remains as the retroflexion or retroversion in the pelvis.

In this way is produced the *incomplete retroversion* or *retroflexion* called by the French the "*sacciform dilatation of the uterus.*" Here we find an interesting application of Bandl's description of the peculiar formation of the lower

FIG. 100.

SHOWING INCOMPLETE RETROFLEXION OF GRAVID UTERUS. THE BISACCULATED UTERUS. (ROBERT BARNES.)

R. Rectum. OU. Os uteri. B. Urethra and bladder.

segment of the uterus. The pelvic pouch which contains the head or breech is formed by the stretching of the lower segment below Bandl's ring. The abdominal pouch which holds the larger bulk of the fœtus is formed by the growth of the body of the uterus proper.

These two pouches thus formed may persist throughout the pregnancy, the larger one in the abdominal cavity, the less one in the pelvic cavity. These phenomena have been distinctly traced and observed from beginning to end by Robert Barnes. The above process may be regarded as the ordinary way in which Nature releases herself from the dangers of pelvis-locked uterus. In some cases the advancing enlargement of the abdominal pouch lifts out the pelvic pouch. Thus the gestation becomes wholly abdominal.

This favorable issue, however, does not always arise. The two pouches develop as described; the pelvic portion still remains so considerable that the os uteri is kept fixed above and behind the symphysis pubis; and so, when the patient falls into labor, the pelvic cavity is filled with the pelvic pouch containing, perhaps, the child's head; and it is thus impossible to lower the os uteri into the pelvis, and so to afford a passage for the fœtus. This is shown in Fig. 100.

Merriman and Denman related cases which appear to have been of this kind. Scanzoni ("Lehrb. der Geburtsch," 1867) says the "partial" retroversion is rather a fault of form than of position. It is always caused by pressure of the part of the child upon the posterior lower wall of the uterus, and is especially observed when, with slight pelvic inclination, the fundus of the uterus falls down through the relaxed abdominal walls. The trunk of the child thus sinking forwards, the presenting head pushes the relaxed hinder wall into the sacral hollow in form of a sac. The vaginal portion (cervix) is pushed forwards. This form, Scanzoni says, is only seen in the last two months. It causes no interruption to pregnancy. But Hecker observed a remarkable case in the sixth month. After repeated attacks of dysuria, active pains set in; the fundus was felt above the womb, the os uteri above the symphysis, the pelvis filled by a uterine pouch. This at length rose out of the pelvis, and the membranes came down. Oldham relates a still more striking case ("Obstetr. Trans.," 1860).

This case again illustrates Bandl's description of the behavior of the lower segment of the uterus. The head, instead of lodging in and distending the yielding anterior wall of the lower segment, as is the rule, finds accommodation in a pouch formed in the posterior wall of the lower segment.

The following case was seen by Robert Barnes in conjunction with Drs. Hilliard and Brunton. A lady, a week before term of gestation, complained of headache and œdema of the face and legs. The urine contained albumen, blood-disks, and casts. Taken in labor, no os uteri could be found until anæsthesia was produced. The posterior wall of the vagina was then felt closely compressed against the anterior wall by a rounded firm mass filling the cavity of the pelvis. Passing the finger up the vagina, the os uteri was found soft and patulous above the symphysis. Through the os could be felt a hard rounded mass, which was taken to be the fœtal head covered by the membranes. This head came close to the rounded mass in the pelvis, giving the idea of two heads interlocking. This intrapelvic mass presented a hard ridge unlike the head, and Dr. Brunton, on careful auscultation, could only hear one fœtal heart. The abdomen was irregular in shape; the enlargement was transverse and bilobed, suggesting twins. An endeavor was successfully made to push up into the abdomen the mass that occupied the pelvis, so as to enable the head which lay above the pelvis to be seized by the forceps. When the mass was lifted into the abdomen, the os uteri came down into the centre of the pelvis. The cervix was then dilated by Barnes's bags, and delivery effected by the application of the long forceps. The child, small but mature, was born alive. Next day mother and child were doing well. The case proved to be one of incomplete retroversion; a pelvic pouch contained the breech, an abdominal pouch contained the head. The pressure upon the pelvic and abdominal vessels and upon the bladder was probably the cause of the albuminuria.

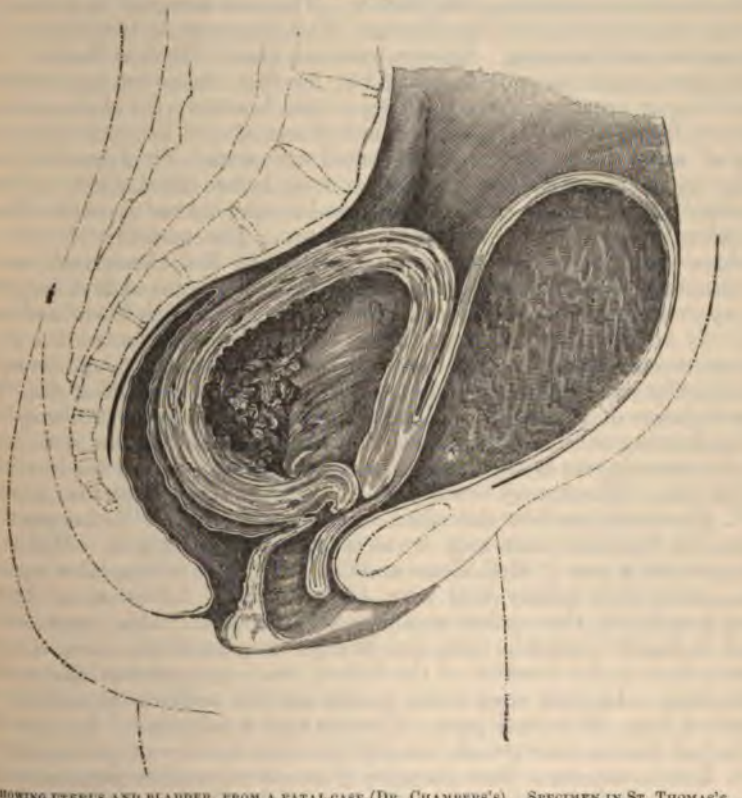
Terminations.—1. *Recovery* may happen by *restoration* of the uterus *spontaneously*—perhaps the most frequent event—or by surgical manipulation.

2. *Recovery* is occasionally effected by the safety-valve process of *partial outgrowth* or sacculation of the uterus upwards into the abdominal cavity—that is, by the conversion of "complete" into "incomplete" retroversion.

3. *Recovery by abortion* is not uncommon. The immediate diminution in ulk of the uterus and the cessation of the attraction of blood to the pelvis ring quick relief. Arthur Farre says:[1] "The sequelæ, when reposition annot be effected, are usually premature expulsion of the ovum, or sloughing f the uterine parietes, and slow discharge of the contents by fistulous openngs into the vagina, rectum, or bladder." Some of the cases thus described ere most likely cases of ectopic gestation.

4. *Death* by blood-poisoning; the matters which should be excreted by he kidneys being retained in the system—*urinæmia*. This, Robert Barnes ays, was the main cause of death in four cases observed by himself. Braun[2]

FIG. 101.



SHOWING UTERUS AND BLADDER, FROM A FATAL CASE (DR. CHAMBERS'S). SPECIMEN IN ST. THOMAS'S. (ROBERT BARNES.)

relates a case in which death followed eclamptic attacks associated with *Bright's degeneration of the kidneys* and secondary uræmia.

5. In many cases conjoined with urinæmia there is *disease of the bladder*, as intense congestion, hemorrhage from the mucous membrane, excessive distention and paralysis, inflammation, even sloughing of the mucous coat. Schatz relates[3] a case in which not only the mucous coat but the muscular coat also became necrosed and entirely separated. Several cases are recorded

[1] Cyclopædia of Anatomy.
[2] Klinik der Geburtsk.
[3] Archiv für Gynäkologie, 1870.

of partial or complete exfoliation of the mucous coat. Robert Barnes has seen one. Wardell and de Havilland Hall describe one ("Brit. Med. Journ.," 1871). In this case Wardell regarded the membrane cast as a croupous plastic exudation. On its inner surface were gritty deposits consisting of oxalate of lime and uric acid. Moldenhauer relates ("Arch. f. Gynäkol.," 1874) a fatal case in which the whole mucous coat, with muscular fibres attached to it, was found detached, necrosed in the bladder. The pyramids of the kidneys were full of blood. Luschka ("Virchow's Archiv," 1854) relates the case of a woman who died in the twentieth week of gestation after three weeks' retention; the catheter failing, the bladder was tapped above the pubes. She died twelve hours after the operation. Exfoliation of the mucous membrane of the bladder is not necessarily fatal.

6. *Death from rupture of the bladder.* The case narrated by Lynn (1771) is that referred to by William Hunter. Van Doeveren, of Groningen (1765), relates two similar cases. Schwarz relates a case ("Medical Record," 1880). This issue would be more frequent but for four compensating factors: (α) dribbling or overflow; (β) stretching of the bladder; (γ) absorption or exosmosis from the bladder; (δ) diminished secretion of urine, the skin throwing off water, in all probability charged with urea. Thus death will occur from urinæmia, shock, and exhaustion long before the bladder will burst. Probably some sudden sprain or violence brought to bear upon the distended bladder is necessary to determine rupture. The quantity of urine that gathers varies from three to twelve pints. In Dr. Chambers's case the woman measured 39 inches round the abdomen. It was at first supposed to be an ovarian tumor. Twelve pints of fluid charged with blood, and having scarcely any urinous odor, were drawn off. A fœtus of four or five months' gestation was removed. The uterus was fixed in the pelvis. At the autopsy the bladder was found to contain two pounds by weight of black clot. There was no trace of peritonitis. There is a grand specimen in St. George's Museum showing enormous dilatation of the bladder and ureters, with necrosis of the inner layers of the bladder and appearances of the bladder having given way. The history is wanting. The fœtus is of about four months.

7. *Peritonitis* has been described as a cause of death. We believe it to be rare. In five fatal cases seen by us there was no peritonitis. Misley, however, relates a case ("Med. Times and Gaz.," 1855) in which, after reposition, the patient died, twenty days later, of peritonitis. Adhesions of intestines were found, and the ureters were distended fourfold. This latter fact renders it highly probable that, like the great majority of cases, retrograde obstruction to the function of the kidney was an important factor in the fatal issue. In some cases where no autopsy was made, peritonitis has been inferred from the intense pain. But this sign is fallacious. In cases where pain had been so interpreted, autopsy revealed no trace of peritonitis.

8. Death may ensue from *gangrene of the uterus*, or other parts compressed. Burns says inflammation and gangrene of the vagina and external parts have been produced. We have already mentioned a case—the one in which the uterus was removed by gastrotomy, in which the uterus, enlarged by fibroids, fell into necrosis.

9. *Shock and exhaustion* enter into every case, but they may be the main fatal factors.

10. *Rupture of the posterior wall of the vagina*, caused by violence of the expulsive efforts, has been noted.

Treatment.—If the displacement is recognized in the early stage, before urgent symptoms have arisen, the simple and effective treatment is to keep the uterus *in situ* by a suitable Hodge pessary. In this way not only may abortion be frequently averted, but the occurrence of incarceration and the

attendent dangers will be obviated. If this opportunity be lost, and the case has developed into danger, successful treatment becomes more doubtful, but the course to be pursued is well-defined.

1. *Pass the catheter.* Use a flexible male instrument, and, in anticipation of difficulty, it will generally be wise to induce anæsthesia. The point of the catheter must be directed close up behind the symphysis. It is not always easy to empty the bladder, even when the catheter has entered it. It should at first be passed in as far as it will go; then, as the urine ceases to flow, draw it gradually forward, and generally more urine will continue to flow; towards the end, gentle external pressure should be made. The bladder, it must be remembered, is paralyzed. Sometimes the stream is obstructed by detached mucous membrane, by blood-clot, or mucus. Where this is suspected, a stream of tepid water may be injected through the catheter.

2. The bladder being emptied, the *reduction of the uterus* by taxis may be tried. Difficulty from two causes may oppose. Adhesions may bind the uterus down, as in Blundell's case. Moldenhauer's case is a similar example. We believe this complication is very rare.

The other difficulty is from the swelling of the parts contained in the pelvis. When the bladder is emptied, under rest this may to some extent subside, so that it is not desirable to push the attempt at taxis too abruptly. If gentle efforts do not succeed, it is wiser to keep the woman on her left side in a semi-prone posture, to give a subcutaneous injection of morphia, to empty the bowel by enema, then to introduce a Barnes's bag into the rectum. In this way Playfair reduced the uterus. In one case in Robert Barnes's hands, at the London Hospital, this plan failed; but in two others at St. George's it completely succeeded.

This failing after some hours, taxis may be again tried. The manœuvre is as follows: The patient under anæsthesia, in semi-prone posture, one or two fingers are passed up the rectum so as to get a fair purchase on the right side of the fundus of the uterus. Steady pressure is then made, not directly upwards, but over towards the left ilium. The object is to release the uterus from the over-arching promontory. Thus pushed over to the side the fundus finds room in the retreating excavation at the side of the promontory. As soon as this is attained, the fundus will rise forward with little difficulty, sometimes even with a spring. We have succeeded in a difficult case by what may be called the bipolar method—that is, by combining with pressure on the fundus, as described, traction of the cervix in the opposite direction. It may even be useful to pull upon the cervix by help of Barnes's axis-traction vulsellum forceps.

3. *Induction of abortion.* Taxis failing and urgent symptoms persisting, reduction must be facilitated by first lessening the bulk of the uterus. This can be done in one of two ways. If the os uteri is accessible, a sound or stilet may be passed into the uterus to puncture the amniotic sac, and even to break up the ovum. The immediate effect of this is to reduce the volume of the uterus. Then the tissues generally shrink a little, and the taxis, tried again at the end of a few hours, may be successful. At any rate the excessive pressure is lessened, and time is gained. The next effect is abortion. The ovum cast out or extracted, a further reduction of volume is gained, and, as far as pressure is concerned, the danger may be considered at an end. But it may be difficult to reach the os uteri; then we have a resource in tapping the uterus through its posterior wall. The best instrument is Dieulafoy's aspirator-trocar. The forefinger of the left hand applied inside the vagina or rectum discovers the most bulging part of the uterus, and the trocar, guided by it, is pushed into the uterus, taking care to enter perpendicularly. The rectum is to be preferred, as offering more certainty of

penetrating into the body of the uterus. If this has been successfully practised, abortion follows.

Where it has been found impossible to pass a catheter, reduction of the uterus being also impossible, the expediency of puncturing the bladder above the pubes may be considered as well as puncturing the uterus. The aspirator-trocar may also serve to puncture the bladder. In the "Obstetrical Operations," three cases are recorded.

When the symptoms are not urgent, the bladder being kept empty, and there is no marked eccentric pressure, it is not wise to use any great effort to reduce at once. We may try the action of a Hodge pessary. The gradual influence of this instrument may reduce the uterus within twenty-four hours, as we have seen in a case at St. George's Hospital. The pregnancy was not disturbed.

After-treatment. Absolute rest, care in emptying the bladder by catheter every six hours, sedatives, light diet, combine the principal indications. The bladder will demand special care, as cystitis is common. An important point after reduction is to prevent the uterus falling back again by adjusting a Hodge pessary. Richter, Baudelocque, and Simpson advised this. Looking to the history of retroversion, and regarding it as a condition existing before pregnancy, the *prophylactic treatment* should have prominent attention. We have on many occasions used a pessary to support the uterus when retroverted during the first three months of pregnancy, as a precaution against impaction, and to obviate and relieve retention of urine.

Retroversion, or rather retroflexion, may occasion difficulty even after delivery at term. The uterus remaining uncontracted, and therefore enlarged and flaccid, may bend back, and become locked in the pelvis. Retention of urine may result. This accident will be more fully described in the history of labor.

The general rules, then, may be thus summed up: (1) Empty the bladder; (2) make a gentle attempt at reposition; (3) if this fail, be governed by the urgency of the case; if there be great distress, induce abortion or puncture the uterus by the aspirator-trocar, and wait; (4) when abortion has taken place, make further cautious attempts to reduce; (5) if there be still difficulty, wait again; (6) when the uterus is reduced, support it in position by a suitable Hodge pessary.

The history of *partial or incomplete retroversion*, with sacculation in the abdomen, more properly belongs to "dystocia," under which head it will be described.

Prolapsus or Procidentia of the Gravid Uterus.—This may be *real* or *apparent*. A minor degree of prolapsus is frequent in early gestation. We have seen that it exists in one form as a condition of retroversion. But it may exist without the retroversion to the extent previously described. The uterus rests upon the pelvic floor, the os pointing between the labia, and the fundus not seated below the promontory, but pointing to the brim. The axis of the uterus will pass in front of the promontory.

The effects of this descent are (1) to pull down the bladder and to cause irritability of the bladder; (2) to press upon the rectum and cause constipation. Locomotion is also somewhat impaired.

In such a case it is wise to raise and keep the uterus at its proper level. This is done by adjusting a suitable pessary. It should be worn until the uterus is large enough to rest upon the brim. This will commonly be about the fourth month.

In some cases, comparatively rare, the gravid uterus escapes almost entirely from the pelvis, the os uteri being found at the lowest extremity of a rounded fleshy mass. The vagina is completely everted, and forms a cov-

ering for the procident mass. As the uterus grows it is liable to become gripped by the vulva and strangled. Hence the obvious importance of early reduction. It has happened that procidentia persisted beyond the sixth month of gestation, when reposition can hardly be effected unless the uterus be first reduced in bulk by removing its contents.

The subject belongs more properly to dystocia. We may here state that conception may take place in a procident uterus, copulation being performed within the cervix uteri.

Procidence may occur suddenly under severe strain.

Apparent procidentia consists in hypertrophic elongation or outgrowth of the cervix uteri. This will be described under "Dystocia."

Anteflexion and Anteversion of the Gravid Uterus.

For the greater part of our precise knowledge of this subject we are indebted to Graily Hewitt.[1]

In early pregnancy there occurs, as we have seen when describing diagnosis of gestation, Fig. 96, a normal increase of nutation of the uterus. Hence in many cases a degree of irritability of the bladder. But in some cases this nutation is so extreme that the fundus gets locked behind the symphysis. Incarceration with anteversion is necessarily less frequent than with retroversion. The symphysis presents no overarching like the promontory to prevent the rise of the fundus uteri. But it may occur. Hewitt cites cases from other authors, and describes cases that came under his own observation.

As in retroflexion, anteflexion may take place *after pregnancy* has begun, or it may have existed *before the pregnancy*. Hewitt thus sketches the history: "In many cases the uterus is anteflexed in the first or second degree with first degree of anterior rotation. Pregnancy occurs. An unusual degree of sickness is observed from almost the moment that pregnancy begins. There is great frequency of micturition. Walking and sitting aggravate both these symptoms. The patient is more or less uncomfortable in other respects. This condition persists up to the middle of the third month. Then the symptoms undergo a change—either improve or become very much worse. If they improve, that indicates that the bend in the uterus has given way, the organ is expanding more easily, and rising up out of the pelvis. If, on the contrary, there is intensification of the symptoms, this means that incarceration is present. The incarceration, perhaps, is only temporary; at the end of a few days the expansion does the work required, and the uterus rises.

"In another set of cases the history is as follows: The uterus has been anteflexed for some time. It is hard, rigid, and firm in texture. Pregnancy occurs. Instantly great pain is felt; sickness is very troublesome; so, also, great micturition. The patient continues to go about; the uterus is not kept at rest; at the end of about two months abortion occurs. In some cases the patient loses blood from time to time—the indication often of impending abortion, but not necessarily so."

The *diagnosis* is not difficult. The os uteri is very far back, and the dense resisting tumor, the anteflexed uterus, is felt through the vaginal roof. As it increases in size it assumes an oblique position. This was so in Ulrich's fatal case, and Hewitt verified it in two cases. The *treatment* in the milder cases consists mainly in rest and expectancy, giving the uterus time to right

[1] Diseases of Women, 4th ed., 1882.

itself under advancing development. The dorsal or reclining postures are to be observed. In more severe cases the patient must take to bed. An air-ball pessary, worn from time to time, may by elastic pressure lift up the uterus. Hewitt speaks well of his cradle-pessary in some cases, and reasoning from our own analogous experience in retroversion, we cannot doubt the importance of this practice. The caution, however, is necessary, that the patient should be under observation, and not indulge in free exercise.

Anteflexion of the gravid uterus, with lax or pendulous belly. The "*utérus en bésace.*" This condition is observed in some women whose tissues are weakened and left stretched by previous gestations. The abdominal walls offer no support to the growing uterus, and the uterus itself, partaking of the general laxity of tissue, bends or bags forwards, riding over the symphysis like a pack-saddle. In some cases there is actual hernia of the body of the uterus, the recti muscles having been stretched asunder in labor, so that the fundus uteri is covered only by stretched aponeurotic membrane, connective tissue, and skin.

The uterus may develop to term under this condition, and give rise to dystocia, from lack of aid of abdominal muscles and loss of relation between its axis and the pelvic axis. How to deal with this case will be described under "Dystocia." During gestation, the case is best met by a well-adjusted belt, which grasps the uterus well from below, carrying it back and upwards, thus supplementing the lost power of the abdominal walls.

CHAPTER XI.

THE DISEASES OF GESTATION.

"Fœmina plurimis afficitur malis ex solâ graviditate oriundis."—BOERHAAVE.

As a general proposition it may be stated that the diseases of the gravida may be divided into:

A. Pathological exaggerations of the physiological conditions of gestation.

B. Pathological processes continued from the pre-gravid state, or grafted upon the gravid state. In either case the disease, in its origin independent of the existing gravidity, becomes modified by it.

The diseases which are the expression of physiological excesses are essentially, if not directly, diseases of high nervous and vascular tension; and the pathological processes originating independently of the gravid process equally fall under the influence of the high tension of gravidity.

The diseases of the gravida are thus stamped with an opposite character to those which affect the puerpera. The diseases of puerpery are essentially diseases of lowered nervous and vascular tension.

The characteristic diseases of gestation then are convulsions in various forms, hemorrhages, effusions, albuminuria. The characteristic diseases of puerpery are septicæmia, thrombosis, mania. The first class have for their genetic feature centrifugal force, action from the centre to the periphery. The second class have for their genetic feature centripetal force, disintegration of tissue, absorption, excretion.

The study of the diseases of the gravida is rich in illustrations of the genesis of disease even beyond the domain of gestation. In this study we may acquire faith in the aphorism: *Pathology is simply physiology working under difficulties.*

There are few opportunities of observing the initiatory stages of morbid processes with so much precision, under conditions so simple and so complete as those afforded by gestation. A woman who becomes pregnant may be regarded as the subject of a scientific experiment performed under more exact conditions than can often be commanded in the physiological laboratory. We begin with a healthy subject. She becomes pregnant. From that moment she is under the dominion of a new impulse which, acting upon every tissue and every organ, tests their structural soundness and working capacity. Hence the aphorism or law which we have already enunciated: *Pregnancy is the great test of bodily soundness.*

If the subject prove sound, and no serious disturbing cause from without intervene, the equilibrium between the new motive power, and the organs acting under this power, is preserved. But if from any cause the happy balance be disturbed, so that the physiological strain upon the organs be in excess of their capacity to respond, there will be danger of a break-down. In the gravid state the system strained to the utmost does not easily tolerate the concurrent course of physiological processes carried to excess, or of engrafted pathological processes. The consequence is, either that the pathological process will develop into more serious degrees, entailing perhaps organic changes, not ceasing with the gravidity; or that the system, rebel-

ling under the pressure, refuses to carry on the gravid process; and so abortion solves the difficulty, thus not seldom averting a fatal issue.

Abortion, then, is an indication of a system or organ overtaxed, or of disease; and is a means adopted by nature for relief or cure. That is to say, abortion is often conservative as regards the gravida.

Under the testing power of gestation, latent morbid conditions are evoked. Of this law many instances will appear in the sequel, illustrating the genesis and evolution of disease. To cite one here, ague may be mentioned. Years after having suffered from ague, the subject considered cured will be seized with aguish fits on becoming pregnant. Paget has called attention to the like revival of ague under the trial of surgical operations.

Physiological processes strained to excess do not necessarily induce abortion. Mother and child may be imperilled or destroyed, or they may struggle on with more or less distress to the natural termination. Certain phenomena, sometimes regarded as diseases, really serve as regulators or moderators of the forces at work, tending to keep the equilibrium. Amongst these may be cited, salivation, pyrosis, vomiting, diarrhœa, hemorrhage, as hæmoptysis apart from tuberculosis, hæmatemesis, melæna, hæmaturia, bursting of superficial veins, hemorrhage from the cervix uteri and vagina and from the decidual cavity. Thus abortion and other evils are averted.

Nor do independent morbid processes necessarily lead to abortion. But when abortion does not ensue, the morbid processes already in action are likely to be intensified, and to persist after the gravidity is over. On the other hand, most of the diseases arising out of excess of physiological actions may, when the gravidity is at an end, disappear, leaving no trace of organic lesion.

These leading facts before us, we can with more intelligence follow the evolution of disorder and disease in the gravida, and grasp the relations of phenomena essentially linked together but which must be described in succession.

A. **Pathological exaggerations of physiological processes proper to gestation,** or pathological conditions arising in the previously healthy woman under the impulse of gestation.

The logical and clinical order of exposition of these conditions is the same as that pursued in the chapter describing the natural history of gestation. If we take the nervous system first, it is because there is reason to believe that this part of the organism is first affected; but it must be remembered that the vascular system and the other organs, and notably the blood, almost immediately feel the new impulse, and work for good or evil with the nervous system.

The Neuroses of Gestation.—The increased psychical, emotional, and diastaltic mobility occasionally reveals itself in ultra-physiological excess.

A general proposition may be stated which applies more or less to all nervous aberrations of gestation. The nervous system is tripartite in analysis, but it is one in reality. The emotional function is rarely affected without involving the psychical and diastaltic functions, and so it is with each in turn. We may, indeed, often discern which is the first to be disturbed; it is nevertheless abundantly proved by clinical observation that all three functions are quickly affected together; and that as the disturbing acts become more frequently repeated in one direction, the stronger, the prompter is the associated disorder of the other functions or nervous centres. We have not here dwelt distinctly upon the ganglionic centres and the functions of this system. But although not so open to direct observation, there can be no doubt that this part of the nervous system is in equal solidarity with the rest.

B. **A group of Paralytic Affections.** 1. Of the special senses, as amaurosis, deafness, loss of taste, loss of smell. Hemiplegia, paraplegia, depending or not upon lesion of the nervous centres.

The neuroses developed under excess of physiological action are:

a. A group of convulsive affections—as vomiting, singultus, reflex convulsion simple (cramps, twitchings in the legs), epilepsy, tetanus, chorea, hysteria, puerperal eclampsia (including the history of albuminuria gravidarum).

b. Reflex paralysis, as paraplegia.

c. A group of mental disorders (including puerperal insanity).

The Vomiting of Gestation.—Usually classed with the diseases of the stomach, we do not hesitate to place it first in the rank of convulsive disorders. The familiar symptom of physiological gestation is simply the expression of the concomitant high nervous tension. When a new motive force is created, there must be a provision for the maintaining the balance between the quantity generated and the quantity applied to its destined use. Any excess must be discharged. Vomiting helps to perform this regulating office. It is even less rational to call vomiting a disease of the stomach than it would be to ascribe to disease of the stomach the vomiting which attends disease of the kidney or of the brain. The stomach may be perfectly healthy. It is simply the seat of election for the discharge of superfluous nervous energy.

Etiology of the Vomiting of Gestation.—Given the centric irritability, what are the eccentric or peripheral irritants? The first class of causes must be sought in the womb itself. Bretonneau supposed that the sympathetic vomitings depended upon the difficulty the uterus experienced in distending, and upon the special irritation that might result from its rigidity. Translated into the language of modern science, "sympathetic" is "reflex." Many facts lend support to Bretonneau's theory. Thus the vomiting is more severe in first pregnancies; it occurs early in pregnancy—that is, when the new growth is telling most upon the undeveloped uterine fibre; whenever the uterine fibre is suddenly or rapidly stretched, especially in pregnancy, vomiting readily occurs, as under the rapid formation of liquor amnii, the spontaneous or artificial dilatation of the cervix. The occurrence of vomiting in the morning on assuming the upright posture is also explicable on this hypothesis. This posture causes a sudden hydraulic pressure upon the uterine vessels, thus distending the uterine tissue.

In another class of cases the uterus, subject to external pressure, excites vomiting. Moreau relates a case of locking of the uterus under the promontory, in which severe vomiting set in, relieved on releasing the uterus. Mayer and Ulrich give cases of vomiting with anteflexion, relieved by supporting the uterus. Graily Hewitt[1] insists that the cause is anteflexion or retroflexion, and explains the morning attack by the sudden change to the upright posture, thus throwing the weight of the intestines upon the uterus. But it is a fact that vomiting often comes on before getting up. Accepting to a certain extent Hewitt's theory, we believe the morning sickness is more frequently due to hunger and weakness. And we have another theory to offer. Its constant occurrence in the morning seems to imply that at this time there is a maximum of central nervous irritability, so that comparatively slight peripheral causes will then act with more effect. The immediate irritating cause we believe to be the stretching of the uterine fibre under the eccentric pressure of the growing ovum and the turgescence of the uterine vessels. This turgescence receives a sudden increment under the hydraulic

[1] Obst. Trans., 1871.

pressure which takes place on assuming the erect posture. In addition to this, there is the proclivity arising from fasting.

An analogous condition is seen in some cases of *dysmenorrhœa*, especially if depending upon narrowing of the os externum uteri or flexion—frequent causes. Here the analogy between menstruation and gestation is enforced. In both there is the predisposing exalted nervous tension and the uterus distended by developed decidua and blood.

Rapid artificial distention of the non-pregnant uterus will cause vomiting. This is seen in dilatation by laminaria-tents.

Certain morbid conditions of the uterus give rise to vomiting. Henry Bennet and Richelot recognized inflammatory conditions of the cervix as the cause.

Emotions, if intense and of oppressing kind, may start uncontrollable vomiting. Robert Barnes saw in consultation a lady who suffered severely in her first gestation, went lightly through the three succeeding pregnancies, and when one month pregnant for the fifth time, underwent severe family trials, came home exhausted, was attacked by unremitting vomiting, and died in a few days. We have seen other cases of vomiting induced by severe mental shock, also ending fatally notwithstanding the induction of abortion. Vomiting so induced under the exciting action of emotion is indeed the most dangerous form. In another case, that of a young lady of singular beauty, incoercible vomiting set in between two and three months after marriage. She had conceived probably immediately after marriage. Her husband committed murder and suicide. The wretched widow also found herself syphilized. Haunted by the dread of bringing forth a child foredoomed to insanity and syphilis, she implored that abortion might be induced. Her prayer was not assented to, and in a week she died exhausted.

An offending body in the uterus is a not infrequent cause. Thus we have known a dead fœtus retained cause severe vomiting until it was expelled. A diseased placenta or fœtus will act in like manner. Some of the most severe cases we have met with were cases of hydatidiform degeneration of the placenta. This probably acted, partly, at least, by distending the uterine fibre. McClintock relates a case of severe vomiting due to an intrauterine polypus. This is not uncommon. Pain and vomiting cease when the polypus is extracted from the uterine cavity. The retention of a detruncated head *in utero* may have the same effect. Perfect relates a case. Dance relates a fatal case at three and a half months in which he found inflammation of the decidua; another, also fatal,[1] from inflammation of the chorion and amnion at four months, and a third from softening and engorgement of the uterine walls.

Intercurrent Disease.—We have known *whooping-cough* attacking a pregnant woman determine severe vomiting. This is not surprising when we reflect that a convulsive affection is grafted upon a system strongly predisposed to convulsion.

Alcoholism has in our experience given rise to or kept up severe vomiting This form is the more grave because alcohol is the popular remedy, and one most easily abused.

Albuminuria, as a cause, was pointed out by Sir J. Simpson. We have verified this on many occasions. Usually eclamptic convulsions attend albuminuria; and it is not surprising that convulsion in the form of vomiting should be evoked.

There has been noticed a deficiency of urea in the urine. Thus, we may have a condition analogous to that described by Andrew Clark as "renal

[1] Arch. Gén. de Méd., 1829.

inadequacy." On the other hand, it is probable that, as in some cases of incoercible hysterical vomiting, the formation of urea is scanty, and that some is thrown off by the vomit. The vomited matters should be examined for this and other conditions.

Course of the Affection.—Passing over the physiological vomiting, which is not injurious, and usually abates at the end of the third month when the uterus rises out of the pelvis, we may note that: 1. There are cases of pathological import within the first trimestrium. The most serious of these are the cases in which severe mental shock is the starting-point. In these the vomiting sets in perhaps suddenly, with unusual severity, is attended by gloomy depression passing into despondency. These cases may run rapidly to a fatal issue, resisting all treatment, even the induction of abortion. The pulse rises in frequency, sinks in power, the temperature rises, and yet the ovum retaining vitality, we can hardly admit septicæmia as a factor. But here, as in all aggravated cases, a form of blood-poisoning sooner or later complicates the condition. First, there is *starvation*, giving strong impetus to the process of absorption; secondly, no adequate material for nutrition being supplied from without, *the system feeds upon itself*—that is, a rapid process of disintegration of all the tissues, most marked in the fat-tissue, is set up. The blood is degraded and empoisoned. This condition intensifies the vomiting, and renders treatment more difficult. If the patient survives long enough, she becomes emaciated to the last extreme. The secretions, the urine especially, are scanty. Some albumen commonly appears in the urine. These cases are not to be confounded with those in which albuminuria plays a primary part; but we believe that, as in these, uræmia enters as a factor. Delirium sets in towards the end.

All these events may occur within the first trimestrium; they are more frequent in the second trimestrium—that is, having begun during the first, they culminate in the second.

A point of great clinical interest is, that once started, the convulsive disorder acquires intensity by repetition of the attacks. Slighter exciting causes will provoke a fit. The nervous centres, weakened by the repeated shocks and by defective nutrition, become inordinately susceptible to centripetal or centric impressions. And we may witness in severe cases how the several nervous centres react upon each other. At first, the excitant of vomiting is simply diastaltic; presently, a thought, an emotion, and soon the slightest physical disturbance, the most ordinary impressions upon the senses, will provoke an attack. The smell of cooking becomes an intolerable offence; a bright light; a loud noise vibrates through the organism, and irrepressible vomiting or singultus breaks out.

At this stage, diarrhœa, the evidence of toxæmia, often sets in; marasmus soon succeeds, and the situation is rapidly becoming critical.

It appears to us as extremely probable that incoercible vomiting induces or aggravates organic change in the liver and kidneys. We have seen it as the first symptom of acute yellow atrophy of the liver.

When vomiting sets in after the fourth or fifth month, and *à fortiori* later still, the earlier stages having been passed without unusual distress, we may presume that the cause is a dead fœtus, albuminuria, septicæmia, alcoholism, or the rapid distention of the uterus by excessive secretion of liquor amnii.

In all of these cases the vomiting will probably persist so long as the uterus retains its burthen. In a certain proportion of instances Nature solves the difficulty by abortion. In some, tolerance is induced under treatment and time. Burns observed that vomiting ceased on the death of the fœtus; but this is not constant.

PROGNOSIS.—The majority of cases recover without the interruption of gestation. But in a far larger proportion than is commonly accepted, death is the termination unless averted by abortion. It is impossible to state the case numerically. But every author of experience gives examples of fatal cases. Severe vomiting should always be looked upon with anxiety, and a prognosis should not be hazarded until the symptoms exhibit decided progressive amendment.

The danger of the affection is sometimes doubted, and this doubt, founded on subjective ignorance, is urged as a plea against the induction of labor. McClintock[1] says, "With a very moderate amount of research I have been able to collect close on fifty authentically recorded cases, and I know of others which have not been published." We, ourselves, have seen nine fatal cases.

Vomiting is frequently attended by or alternates with *singultus*, another form of convulsion, depending upon disturbance of the ganglionic centre reacting upon the spinal system.

A frequent accompaniment is *pyrosis;* a watery glairy fluid sometimes streaked with blood is ejected.

In the "Lumleian Lectures," 1873, Robert Barnes distributed the cases of severe vomiting into three groups. The *first group*, that comprising cases of severe vomiting within the first three months, includes primigravidæ as well as pluriparæ, although the primigravidæ are the most numerous. In these the preponderating condition is the extreme convulsive tension of the nervous centres. In some the subjects are constitutionally "nervous," susceptible to emotional and physical impressions. In some there is a morbid diathesis. In some, especially pluriparæ, there is probably blood-degradation. Sooner or later, blood-degradation surely supervenes; but this factor does not appear to be necessary to the production of vomiting in primigravidæ in the first month.

In the *second group*, including cases of continuous vomiting increasing in severity, the initial conditions are those which mark the first group. But very soon another condition arises; continuous vomiting implies impaired or arrested nutrition. The influence of this seems to be to increase the irritability of the nervous centres. If the strength can be raised, the susceptibility is diminished. But this is not all. If food be not supplied from without, the starved system feeds upon itself. Absorption goes on actively. The proceeds of tissue-change find their way into the blood and empoison it. At this point the danger is extreme. The blood-poison further increases the irritability of the nervous centres; it oppresses the brain; delirium supervenes; and utter prostration is at hand. Every fit of vomiting acts as a shock, and leaves the system more open to the next attack. At this point, the slightest peripheral or emotional disturbance will excite a fit. Diarrhœa is not uncommon at this stage. It bears further evidence of toxæmia. The indications of danger are: extreme emaciation; a pulse small, easily put out, exceeding 130; hollow, staring eyes; Hippocratic aspect; delirium. We have not seen a patient recover in whom the last symptom had persisted for a few days, supervening on the rapid pulse. The vomiting may now subside; even premature labor may take place; but the patient will sink notwithstanding. In some cases the urine is albuminous. Where this complication exists, the cases are in close affinity to albuminuric eclampsia.

In the *third group*, that in which the vomiting becomes obstinate in the later stages of gestation, the eitiology is sometimes pretty clear. The uterus has rapidly, almost suddenly, undergone excessive distention from undue

[1] Dubl. Journ. of Med. Sc., 1873.

secretion of liquor amnii, or from twins, or a diseased ovum. At this time vomiting has set in. The explanation appears to be this: normally, the uterus grows *pari passu* with the embryo. The adaptation is so well-balanced that there is no strain. But if the contents of the uterus be suddenly augmented, the harmony of correlation is destroyed. The uterus cannot suddenly grow or yield to keep pace with the eccentric pressure within. Its fibres are stretched, perhaps torn, and vomiting results. In other cases there is unmistakable evidence of blood-poisoning. Jaundice attends, sometimes preceding, sometimes apparently induced by the vomiting. The most striking example of cholæmic vomiting is that connected with acute atrophy of the liver.

TREATMENT.—A careful exploration, pelvic and systemic, to discover the causes in operation can alone furnish a rational therapeusis. If we find displacement or inflammation of the uterus, we must lose no time in eliminating these factors; if we find an offensive discharge or hemorrhage from the uterus, we must discuss, with a view to prompt action, the emptying of the organ and disinfection; if we find the uterus distended beyond measure by plural gestation or liquor amnii, we must deliberate as to the probability of the patient tiding over the interval before the natural term of gestation, or the attainment of viability by the fœtus; and if we decide that procrastination is too hazardous for the mother, we must provoke labor without undue hesitation. We are sure that we have seen more reason to regret delay in resorting to this *ultima ratio* than from having had recourse to it too early. Several times have we witnessed a fatal issue because abortion was induced too late. At the same time it is proper to bear in mind that cases occur which seem doomed from the first, against which all means fail.

McClintock tabulates 36 cases in which the induction was resorted to; in 6 of these death ensued notwithstanding.

Copeman's Method.[1] Standing before the operations for arresting gestation comes Dr. Copeman's method of dilating the cervix uteri. This is done by the finger, or, if the os is narrow and hard, by bougies. Cases have accumulated proving the most remarkable success. We ourselves bear testimony in its favor. Unless the indications for bringing the gestation to an end quickly be very urgent, this method should always be tried first. What is the explanation of its efficacy? Until this is established on clear grounds we may be satisfied with using it empirically. It is free from danger, and does not seriously imperil the gestation.

The treatment of the milder cases is generally expectant. Although the patient or her friends may declare that "she vomits everything she takes," the balance of nutrition is still supplied from without. She does not greatly emaciate; she preserves a fair aspect; intervals of cheerfulness follow the attacks of vomiting. Under these conditions we may try a variety of remedies more or less empirical. These may be classed as sedatives, alteratives, antacids, and peptics. Amongst the sedatives, the bromides rank highly, then digitalis, which has the undoubted property of regulating nervous and vascular tension; five-minim doses of chloroform in emulsion; pyroxylic acid; Indian hemp. Simpson spoke well of a teaspoonful of naphtha in tincture of hops, calumba, and soda; carbonic acid in effervescents, lime-water alone or with milk, bismuth, magnesia, nitrate and oxide of silver, chloride of calcium. Tyler Smith, Tessier, and others speak highly of pepsin. Strychnia is sometimes of great service; Metcalfe Johnson (1871) found the hydrated phosphate of lime successful. Salicine, extract of walnut, the oxalate or nitrate of cerium, are recommended by Simpson; Bedford cured

[1] Brit. Med. Journ., 1875, 1879.

by ¼ or ½ grain doses of ipecacuanha two or three times daily. A valuable remedy is caffeine, given in ¼ or ½ grain doses every hour or two; guarana, maltine, koumiss, have their use. A drop of solution of nitro-glycerine (1 in 100) on a lump of sugar is sometimes very efficacious. Ingluvin has been extolled.

The vomiting distresses most when the patient is hungry. It frequently comes on *before getting up*. This is the time then to take some nourishment: hot tea or coffee and milk, lime-water and milk, soda and milk, iced coffee and milk give great relief. Roberts endorses Ringer's plan of giving single drop doses of ipecacuanha wine the first thing before lifting the head from the pillow. In the daytime iced champagne and milk often allays the irritability. The stomach wants the normal stimulus and work to divert it from abnormal courses.

The use of the remedies in the preceding list depends upon the tolerance of the stomach. They may, like food, simply provoke the stomach to rebel. Then we fall back upon the rectum, the skin and cellular tissue, and the lungs as the roads by which nourishment and medicines may be carried into the system. Sedatives can easily be applied in this way; chloroform or ether inhalations, nitrite of amyl the most effective of all, thus give invaluable service; chloral may be administered by enema in scruple doses. Extract of belladonna may be rubbed in over the epigastrium. Beef-tea or milk enemata may be made the vehicle of medicinal agents.

We have found great relief in vomiting and hiccup, from breathing over the mouth of a bottle containing a few drops of ether.

In severe cases of marasmus, the question of *intravenous injection* of milk, of defibrinated blood, of saline solutions, must be considered. The patient ought not to be allowed to sink without trying the effect of these measures, which sometimes give marvellous results. Flying blisters to the epigastrium, followed by morphia or belladonna dressings, have been useful; hot fomentations or water dressings may serve. S. Iffla[1] relates a very severe case promptly relieved by passing a steady current of electricity through the epigastric region.

Then we have the invaluable resource of *subcutaneous injection;* ten minims of solution of morphia are often of the greatest service; one drachm of ether introduced in the same way is especially useful in extreme prostration, lifting up the vital powers and giving the opportunity of supplying nourishment.

In the era of phlogistic medicine, venesection was a favorite resource. Thus Mauriceau relates successful cases, and Smellie relates a case of a woman whom he bled at every monthly period, the vomiting always ceasing, and who thus went on to term. Campbell says: "The irritability manifested during the early months must be attributed to the suppression of an habitual hemorrhage." Hence the first mode of arresting it is to bleed. If venesection is contraindicated, leech the epigastrium. Burns advocated bleeding. In Italy, even now, bleeding is a favorite remedy. We must not omit to watch the secretions. Although diarrhœa sometimes attends, there may be accumulation of noxious matter in the intestines. Enemata will be useful. Slight *ptyalism*, induced by small doses of gray powder, may be tried. Dr. Pagot[2] relates an interesting case of extreme exhaustion recurring in three successive pregnancies, each time effectually controlled by keeping up slight salivation. He says the symptoms were so urgent that life was despaired of. Frequently, no doubt, the function of the liver is impeded or perverted: and we think there is a rational indication to try

[1] Austral. Med. Gaz., 1871. [2] Dubl. Med. Press, 1859.

Dr. Pagot's plan. If mercury cannot be tolerated by the mouth, we might succeed by inunction, mixing belladonna with the mild mercurial ointment.

Then there is the great principle of *rest*. This term embraces rest from emotional influences; physical repose, general and local. In the milder cases, after the morning attack has subsided, exercise is beneficial, but in the severer cases absolute repose may be necessary. By local rest we mean rest for the uterus. It seems certain that, whether it be explained by Graily Hewitt's theory of exaggerated displacement of the uterus, or simply by the ordinary movements to which the uterus is subject, movements of the irritable organ do excite vomiting. What is the remedy for this? Dr. Aubert,[1] reasoning upon Hewitt's tenets and clinical observation, recommended in some cases the use of pessaries. We ourselves have derived signal service from a well-adjusted Hodge pessary in the early months; and this when there was no perceptible prolapsus, version, or flexion. Where there is obvious abrasion of the cervix uteri, applications of nitrate of silver may be of great service.

As in other maladies for the relief of which a multiplicity of remedies are extolled, we may suspect either that the vomiting of pregnancy is easy of cure, or that the beneficial action of the remedies is more apparent than real, or that this malady, being intractable, baffles the search for the remedy. The truth seems to be that under almost any treatment the majority of cases will resist for a time, and then get well. All the remedies specified have been credited with success, the part played by Nature being overlooked. At the same time we should not ignore the fact that, by a judicious application of the means at our command, the severity of the disorder and the consequent shock to the system may be materially moderated, and the path towards natural subsidence be so smoothed that the goal will be more surely reached.

The disease may steal on insidiously but rapidly, so that the time for hopeful action may quickly pass away. If the pulse have risen to 120–130, if there be marked Hippocratic countenance, considerable emaciation, continuous difficulty in keeping down food, sleeplessness, and especially any degree of delirium, it is highly probable that the induction of labor will be too late. It may even provoke distress which will accelerate the fatal issue. But in several cases we have seen there was no albumen in the urine, so that whatever poison there was in the blood the condition was probably different from that which is called uræmia. Comparing these cases with the phenomena of acute atrophy of the liver, and with other cases of rapid sinking in pregnancy, we cannot help suspecting that there is developed some graver systemic or organic disorder than has yet been recognized. The irritative fever, the delirium witnessed towards the end, are the result mainly of starvation. There is first defect of nutrition, so that the sufferer sinks from inanition; but there is also a peculiar empoisonment of the blood, resulting from the absorption of waste material and probably of some peculiar poison developed during the process of starvation.

Of all the cases that come before us, those in which albuminuria is an efficient factor leave the least room for doubt as to the course to be adopted. Abortion or premature labor should be promptly induced. We must remember that eclampsia is probably close at hand, and if not exorcised quickly, will overtake and perhaps destroy the patient. We believe that the induction of labor is imperiously indicated when the pulse rises to 120, the temperature exceeding 100° F., emaciation becoming marked, the stomach intolerant of food, when the patient is harassed by want of sleep, and vomiting is provoked by slight causes and frequently renewed. When once the

[1] Lyon Médical.

balance of nutrition is clearly turned against the patient, so that she is feeding upon the waste products of her own tissues, she is in imminent danger, and the time within which a successful therapeusis can be practised is quickly passing away.

On the other hand, we must not forget that in the majority of cases there is a natural tendency of the vomiting to subside after three or four months. We must, therefore, study patiently to meet the distress by palliation as long as we can, hoping for the time when nature will assert her power and relieve the physician. Giving this principle emphatic approbation, we feel compelled to protest with equal emphasis against a plausible but dangerous aphorism not seldom urged by the disciples of a timid "*far niente*" school: "Treat the disease and let the pregnancy take care of itself." The reply to this, too often enforced by clinical experience, is: "The disease depends upon the pregnancy, and cannot be treated apart from its cause. Whilst you are fighting the assumed disease on empirical principles, the woman is drifting to death."

Reflex Convulsions Simple.—By this term we mean convulsions neither true epilepsy nor albuminuric. We have seen women attacked with violent shuddering, with or without vertigo, but not passing into coma. The fits are accompanied by distressing tremors, and sometimes by syncope. Palpitation precedes and follows. These attacks suggest the term epileptoid; and perhaps the condition is closely allied. But they occur sometimes in women who have exhibited no antecedent epileptic tendency; and epilepsy, according to our observation, is rarely generated by gestation, but is a revival of a latent diathesis.

Cramps, or spasms in the legs, in the abdomen and elsewhere. In minor degree spasms and pains in various muscles may be regarded as simple evidence of the ordinary exaltation of nerve-tension. When they become severe, as they sometimes do, causing loss of rest or sickness, sedative treatment by digitalis, bromides, even opium, may be indicated. They should always dictate a systematic interrogation of all functions, especially of the alimentary and urinary organs. Removing the source of irritation from the stomach may allay the distress. Examination of the urine may reveal albuminuria; and in this case we must act upon the special indications in that affection.

We know women who are always troubled with a *cough* when pregnant. It is not attended with any bronchial secretion, it is purely nervous; it is of an explosive or convulsive character. And cough, especially whooping-cough, will, proclivity existing, sometimes set up true convulsion.

Epilepsy may for the first time break out under the trial of pregnancy, so that it now falls under consideration. But it is more frequently observed as a pathological process antecedent to and revived by the gestation. For the sake of continuity, and for the better appreciation of the interrelations of the neuroses, it is better to comprise the description of the disease in this place.

A case is related in the Lumleian Lectures of a woman whose history revealed a strong hereditary disposition to nervous disorder. After a labor and several abortions, being much exhausted, epileptic fits declared themselves during her seventh pregnancy. A slight fit occurred at every menstrual epoch after this. At the next pregnancy she "took fits" again, and had them frequently during the whole period of nine months. The fits ceased after labor; she nursed thirteen months without fits, but in succeeding pregnancies she had frequent fits, and also during lactation. In her twelfth pregnancy fits recurred; she went to term; severe and protracted fits followed labor, she being semi-comatose between. When pregnant for the

thirteenth time, on quickening she had a very severe fit; a fortnight later the right leg was paralyzed. At five and a half months severe fits set in, with prolonged coma, the paralysis of the leg continued. Labor was induced by rupturing the membranes; she had no fits during labor or puerpery. The paralysis remained. The urine, examined at four different times, showed no albumen. The abortions and the protracted lactations induced a gradual blood-deterioration, the effect of which culminated after six years of reproductive troubles in the first epileptic fit during the nervous tension of gestation.

Although, as in this case, epilepsy will frequently provoke abortion, it is not nearly so likely to do so as eclampsia, indicating that the blood-poison in eclampsia is more noxious and more acute in its formation, and therefore is a more potent irritant of the nervous centres.

The case sketched illustrates the main features of the relations of epilepsy to gestation, namely, the faculty of gestation to evoke a latent organic or functional disposition to epilepsy; the early appearance of epileptic fits on the commencement of gestation; the liability of the fits to be repeated with the advance of gestation; and the renewed proclivity to the disease during lactation. Throughout there is general anæmia. This appears to be the most obvious blood condition. But, as we have explained, anæmia, especially in a pregnant woman, almost always entails some degree of toxæmia, the result of bad nutrition and weakened excreting power. It differs markedly from eclampsia in the absence of albumen from the urine, and therefore of the acute toxæmia which attends albuminuria. It is a chronic disorder called into activity by the degraded blood acting upon nervous centres in exalted tension under the influence of gestation, and affected by the organic changes proper to the epileptic diathesis.

The effect upon the child is not constant. If abortion occur, it is not necessarily through the death of the embryo. The child has on rare occasions exhibited convulsions at or soon after birth; and the *damnosa hæreditas* will in all probability, especially in the case of a girl, sooner or later assert itself.

TREATMENT.—Is there any prophylaxis? Epileptics cannot be advised to marry. Marital intercourse will sometimes cause fits. Gestation is almost certain to exercise a baneful influence. The remedial treatment consists in moderating the fits, obviating the effects of the coma, and restoring general tone. Regulate the secretions; give iron, zinc, bromides, cod-liver oil; good diet; encourage exercise. If the brain show sign of debility, the induction of labor must be considered.

Tetanus, preëminently an affection of exalted centric nervous irritability, is an occasional complication of pregnancy. It is not uncommon in hot countries in connection with pregnancy and labor. Mr. Waring[1] recorded 232 cases observed in India. We have often seen in labor evidence of such extreme reflex and emotional irritability that we have expressed it to ourselves as tetanoid. But we have not seen true tetanus in a pregnant woman which we could identify with what we have seen of tetanus after surgical operations, or of so-called idiopathic tetanus. Sir James Simpson collected 28 cases connected with abortion and labor. In some of these there was no unusual lesion; in some there had been hemorrhage; in some the vagina had been plugged to arrest hemorrhage, and this has been observed to cause peculiar irritation. One observation made by Simpson is undoubtedly true—namely, that in this country tetanus is extremely rare in women independently of pregnancy. Dr. Wiltshire has related two cases, both in pregnant women; both died. Of Simpson's 28 cases only 6 recovered.

[1] Indian Annals, 1855.

It has been generally thought that tetanus in pregnant women is sufficiently explained by comparing the condition of the uterus after labor to a surgical injury. But this is inadequate. It accounts for the source of the peripheral irritation only, not for the exalted responsive centric irritability. Is there a poison *sui generis* at work? The comparative frequency of tetanus in abortion deserves attention. We do not know if albuminuria has been observed in connection with this disease. The convulsion differs in some respects from that usually associated with albuminuria, one great characteristic being the absence of coma. A resemblance is seen in the readiness with which fits are excited. The *treatment* must be based on the same lines as those laid down for puerperal convulsions. Upon absolute rest, nitrite of amyl, or chloroform the hope of recovery must be fixed.

Robert Barnes saw a case in which whooping-cough induced tetanus in a boy aged nine months. He had first trismus, then emprosthotonos, the hands touching the feet, then the body arched back into opisthotonos. Such a case must be studied in connection with the "trismus nascentium."

Chorea.—The investigations of Robert Barnes on chorea render it[1] doubtful whether chorea ever arises in the course of gestation as a new disease. The mass of direct evidence shows that when chorea arises in gestation, there is either a clear history of the subject having suffered chorea as a child, of having acquired the predisposition before pregnancy, or of having inherited a nervous diathesis predisposing to chorea. Andral noticed this, and that recovery followed on abortion. A striking exception to this proposition is found in a case narrated further on, in which scarlatina, causing mitral disease and albuminuria, was followed by chorea at the eighth month of gestation. It is not, therefore, strictly logical to class chorea with the neuroses arising under excess of physiological action. But the affinity which all the convulsive diseases occurring during gestation exhibit, renders it more instructive to study them side by side in the same group.

In the memoir cited the author collected 39 cases of recovery from chorea during gestation, and 17 cases ending fatally. Of the first series, abortion or premature labor occurred spontaneously in 15, in 1 it was induced artificially, and in 23 gestation went on to term. Of the second series, of 17 fatal cases, 4 died undelivered, in 5 abortion or premature labor set in spontaneously, in 1 it was induced, 2 died undelivered, in 5 the matter is not specified.

It must not be assumed from these figures that the deaths under chorea in pregnancy are as 17 to 39. It is almost certain that a larger proportion of fatal cases are recorded. But the figures show, nevertheless, how disastrous the complication is. These facts exhibit the main features of interest as to the relation of chorea to gestation. The two conditions are distinctly antagonistic. Chorea tends to force the termination of pregnancy, or to kill the mother; and pregnancy will hardly suffer a latent proclivity to chorea to remain in abeyance.

In a large proportion of instances the chorea breaks out in the first pregnancy, whilst the subjects are still young—that is, not far remote in point of time from the antecedent attacks of the disease. When it has occurred in one pregnancy, the probability is great that it will recur in subsequent pregnancies, the patient remaining free, apparently cured, in the intervals.

Not only does gestation evoke latent disposition to chorea, but it greatly intensifies the disease. It may be said that the greater number of severe cases, of cases culminating in mania and death, are cases of chorea complicating gestation. Marcé affirms that moral and intellectual disorders are

[1] "On Chorea in Pregnancy," Obstetr. Trans., 1869.

very common, that two-thirds at least show obvious marks of these disorders. Loss of memory, hallucinations, mania occur. This estimate may be overstrained in the case of children, but it is assuredly under the mark in chorea with pregnancy.

In this liability to be evoked under gestation chorea resembles epilepsy and ague, and other convulsive disorders. Other conditions which impair the blood and disorder the nutrition of the nervous centres resemble gestation in disease-evoking power. Thus, Blache notes[1] that exhausting discharges, protracted illness, as in a case of typhoid ending in anæmia, may excite chorea in a choreic diathesis.

The following propositions seem to be established:

1. Chorea complicating pregnancy is attended with more danger both to reason and to life than under other circumstances.

2. In some cases under restorative treatment the chorea has subsided during pregnancy, and the patients have been delivered at term.

3. In some cases premature labor has occurred spontaneously during the continuance of the chorea. This event has been quickly followed by the cure of the chorea; in some it seems to have rescued the patient from imminent death; but in some cases the abortion has been quickly followed by death.

4. Abortion is not due to the death of the fœtus, for this has been frequently born alive. In its tendency to provoke labor chorea resembles eclampsia. Both cause shock; both tend to accumulation of carbonic acid in the blood; both impair nutrition of the nerve-centres, and disturb the function of the great excreting organs—the liver and kidneys.

The pathology of chorea as illustrated by gestation. We cannot here dwell upon the light which pregnancy complicating chorea throws upon the pathology of this disease. This interesting question has been discussed in the "Memoir" already cited. We can only here point out that the theory of "embolism of the small branches of the middle cerebral artery supplying the structures near the corpus striatum," so ably contended for by Hughlings Jackson, is difficult to reconcile with the clinical facts—(1) the frequent recovery of choreic patients; (2) the occasional immediate cessation of choreic fits upon delivery; (3) the *progressive character* of the disease during pregnancy, convulsions increasing in severity, and the gradual development of mania in some cases; (4) the fact that embolism is rare during pregnancy.

There is evidence of tissue-waste. The patients generally emaciate; they sleep badly, and during sleep the convulsions remit or cease. The appetite and digestion are impaired. The temper is irritable; the pulse is often accelerated. In a case witnessed by Robert Barnes in Chomel's wards the diaphragm, larynx, and heart were affected, as shown by hiccup, irregularity of heart's action, and hissing respiration coming on at intervals.

Walshe[2] observed four phases of the urine—(1) febrile, high specific gravity, deep color, odor strong, lithates abundant; (2) great excess of urea, result of muscular waste from convulsive action; (3) oxalates; (4) abundance of phosphates, result of nerve waste. Todd and Bence-Jones confirmed these observations. Beale noticed a large amount of solid matter caused principally by the organic matters; also increase of sulphates; no sugar or albumen. Dr. Fleetwood Buckle gave us several analyses quite in accordance with the above. In one case in which we examined the urine we found no albumen or sugar; it contained 0.4 per cent. of urea, and crystals of urate of soda and uric acid. The case was very severe; it lapsed into mania.

[1] Dictionnaire de Méd., 1834. [2] Lancet, 1849.

We may now venture to state our provisional conclusions as to the primary genesis of chorea, and its secondary reproduction under the influence of gestation. 1. There is in many, if not all cases, an inherited nervous diathesis, or acquired under diseased processes that degrade the blood and tissues. 2. But at the starting of the disease the primary condition of the brain, apart from this assumed diathesis, is simply that of irritation. 3. That irritation is soon complicated with impaired nutrition. 4. That the source of the irritation is a compound of psychical or physical shock and degraded blood. 5. That the disease continuing aggravates itself and the malnutrition of the nervous tissue. 6. That by a vicious circle of action and reaction the choreic convulsions directly injure the nervous substance, and thus the gross or microscopical changes of structure become developed.

In childhood, under favorable medical and hygienic conditions, and the transforming influence of development into adolescence, the disease may be arrested, apparently cured, and is *de facto* cured as far as outward manifestations are concerned; but a certain change of structure persists in many cases at least, only waiting to be recalled into activity under the influence of pregnancy or other conditions which degrade the blood and excite the nervous centres. Of all known influences, pregnancy seems to be the most potent and the most disastrous.

The great sympathetic nerve, as Voisin says of epilepsy, probably plays an important part in chorea.

In connection with the widely accepted theory of rheumatic affection of the heart as a cause of chorea, it is useful to bear in mind how commonly the heart is affected in pregnancy, hypertrophied, and its irritability greatly increased. At the same time, in considering the embolic theory, it should be borne in mind that thrombosis and embolism are rare in gestation. These events are characteristics of the puerperal state, of low nervous and vascular tension, of active degeneration of tissue and absorption.

Chorea causes mental disorders. This it does by the repeated shocks, which at first stun the nervous centres. These shocks are equivalent to concussions; they exhaust and divert the nervous force from its proper uses, and after a time impair the nutrition of the nervous substances, either directly or indirectly, by inducing degradation of the blood. This hypothesis is consistent with the clinical facts that the cerebral disorders are progressive in proportion to the duration and severity of the chorea; and, if not too far advanced, undergo amelioration with the decline or cessation of the chorea.

The effect of chorea upon the child is not sufficiently known. It must be noted at three periods: (1) during intrauterine life; (2) during and immediately after labor; (3) during early infancy.

During the first period it seems probable that the fœtus in which the germ of chroeic diathesis exists may suffer convulsion *in utero* under the same influences which act upon the mother. Precise observations upon this point are defective. Where premature labor has occurred spontaneously or surgically, the embryo or fœtus has generally been alive up to the time, and viable fœtuses have been born alive. If the child survive, it is eminently desirable to put it to a wetnurse rather than to the mother.

TREATMENT.—The great question here, as in other forms of convulsion, is, Can the gestation be allowed to proceed? In some cases nature solves the question by spontaneous abortion. We must accept this as evidence of the rebellion of the system under the burthen. Again, death may ensue if the gestation continue. We must be governed by the severity and obstinacy of the disease, and the extent of the injury inflicted upon the system. We must anxiously watch the pulse, temperature, and general conditions, pre-

pared to act in time. If nutrition be seriously impaired, the favorable opportunity may easily slip away. The general treatment is similar to that indicated for incoercible vomiting. Repose; removal of irritation, psychical and physical; morphia by subcutaneous injections, bromides, digitalis; mineral sedatives, as cerium, bismuth; tonics, as zinc, iron, arsenic. Sedatives are of great service. Succus conii has been extolled by Clifford Allbutt.

The diet should be nutritious; if food is rejected by the stomach then nutrient enemata are resorted to. In extreme cases subcutaneous injections of ether, and intravenous injections of saline solutions may turn the scale to recovery.

If mania break out, or threaten, premature labor should be induced. This step taken in time, may save the patient from protracted or permanent brain disease.

Hysteria.—Pathologists not familiar with obstetrics and the sexual diseases of women are often disposed to call hysteria all anomalous phenomena which they cannot trace to some cause within the range of their study, and to which they cannot give another name. Regarded in this way, many of the aberrant nervous phenomena would fall under the general and vague term of hysteria. But if the phenomena be carefully analyzed by the light of the physiology of gestation, they may for the most part be assigned to one of the acknowledged definite neuroses. Adopting this view, the cases of hysteria will be rare, and will certainly become rarer as our knowledge increases. It is not too much to say that hysteria is an *asylum ignorantiæ*, which will one day be closed.

The phenomena which most commonly call up the idea of hysteria are the various mental aberrations from which few women are altogether free. Capricious appetite, wilfulness, restlessness, languor, idleness, subjective pains more or less defined; changes of character, the "longings."

Some of the subjective troubles which on-lookers find it hard to realize, are real enough to the sufferer. Some are reflex motory or reflex emotional, some, perhaps many, take their rise in the ganglionic system.

Burrow says: "I have seen two cases where hysterical symptoms attended during pregnancy, and the patients almost immediately on delivery became insane." And "puerperal delirium consequent on labor is sometimes predicated, though not absolutely developed during gestation. If while pregnant there attend frequent hysteric affections, preternatural susceptibility, unaccountable depression or exuberance of spirits, morbid aptitude to exaggerate every trivial occurrence, suspicion, irritability or peevish excitation, or, what is still worse, a soporous state, with a very quick pulse, then the supervention of delirium on labor may be dreaded." The prognostic meaning of these signs is interpreted with characteristic clinical sagacity. But surely they are not hysteria, they are the premonitory symptoms of insanity, the "sopor and the quick pulse" may indicate albuminuria.

We only mention here, for the sake of order, the *convulsions* that attend deliquium *from hemorrhage;* the convulsions of the moribund from other causes, as acute yellow atrophy of the liver; and the *convulsions* due to accidental *poisoning.*

Albuminuria gravidarum. Eclampsia gravidarum or **puerperal convulsions**, or *puerperal eclampsia.* The adjective "puerperal" is erroneously applied to describe this grave disorder. Convulsion is a characteristic affection of pregnancy. It is the immediate expression of high nervous and vascular tension. As a clinical fact, in many cases, the convulsions break out before labor sets in; indeed, long before labor is due; in other cases they may break out during labor when nervous tension is at the acme; and it is

only in a comparatively small proportion that the convulsions declare themselves *for the first time* after labor. And in these latter cases, the train was laid during the gestation. On physiological and clinical grounds, therefore, we class this form of convulsion with the other convulsive disorders of gestation. This argument we have enforced and illustrated elsewhere.[1] We may here venture to state a general proposition. The chief acts of reproduction in woman are marked by nervous phenomena allied to convulsion. The orgasm of coitus, the vomiting, cramps, and other phenomena of gestation and labor itself are of this character.

One great essential character of the disorder we now treat of is the concurrent presence of albumen in the urine. This association stamps it with a special type. The complication with albuminuria, not unnaturally, was first observed in Guy's Hospital, the field of the luciferous discovery of Richard Bright. Lever announced his discovery in 1842.[2] Sir J. Simpson confirmed it by independent observations in 1847. In 1840, Rayer[3] announced that he had repeatedly observed his "*néphrite albumineuse*" in pregnant women. We shall offer presently an opinion as to the probable nature of this "*néphrite*." In 1846 Cohen and Delpech confirmed Rayer, showing that albuminuria was frequent in pregnant women. Since then the association is an undisputed acquisition to science. Different theories, nevertheless, still prevail as to the genesis of the albuminuria, as to other complicating conditions, and as to the immediate causes of the convulsions.

Two apparently conflicting clinical facts must be studied in relation to the foregoing propositions: 1. Cases, not rare, are seen in which convulsions break out in pregnancy which were not preceded by albuminuria. 2. Albuminuria, even with œdema, has been noted, and no convulsion has appeared. Litzmann found albuminuria in 37 out of 131 gravidæ; of the 37, 26 were primigravidæ. These facts, and the connected theories, will be discussed presently.

We will first endeavor to describe an attack. It may be analyzed into three periods. 1. The convulsion. 2. The coma. 3. An interval of apparent recovery or of remission.

1. The *fit*. Frequently this occurs suddenly, premonitory symptoms, if any, escaping observation. The patient may have been engaged in her ordinary occupation, when she turns pale, the eyeballs roll in their sockets, the whites alone being seen; the corners of the mouth are drawn, producing a horrid grimace compared by Dubois to the countenance of the fabled satyrs. The face is drawn to one shoulder, the muscles of the face twitch and become contracted, and this contraction quickly extends to the muscles of the trunk and extremities; the fists are doubled, generally with the thumb compressed in the palm by the fingers; sometimes the trunk is bent to one side, more often the back is arched as in opisthotonos. The neck swells, the carotids beat violently, the jugular veins stand out, the face becomes bloated, cyanosed, the eyes even start. The aspect strangely suggests strangulation. There is, as Marshall Hall described it, trachelismus.

The contracting muscles of the neck obstruct the return of blood by the jugulars; the tongue is protruded, it is often bitten and bloody; froth oozes, or is expelled in jets from the mouth. The muscles of respiration, especially the diaphragm, appear as if "set" in tonic contraction. Hence breathing may be suspended for several seconds. This condition of tonic convulsion does not last ordinarily more than twenty or thirty seconds, when it is followed by the clonic convulsive movements. Rapid jerking movements of the muscles

[1] Lumleian Lectures on the "Convulsive Diseases of Women," 1873.
[2] Guy's Reports. [3] Traité des Maladies des Reins.

of the face, body, and limbs now succeed the muscular rigidity. The glottis opens; a short noisy broken inspiration, with stertorous expiration, attends the escape of foam from the mouth. The patient can neither feel, see, nor hear. The pulse, at first hard and strong, now becomes rapid and feeble, capillary circulation is retarded; hence the purple hue especially noticed on the hands and face. Carbonic acid accumulates in the blood. Reflex action for the time is suspended as in other forms of deep narcosis, the sphincters relax, and the urine and feces are discharged. Generally the eyelids refuse to contract on irritation: the pupils respond feebly, or not at all, to light. They are sometimes dilated, sometimes contracted. Towards the end of the paroxysm all these symptoms progressively disappear. The spasmodic movements become less frequent and less violent until they entirely cease. The circulation and respiration become regular, the superficial colorations disappear. Perspiration frequently breaks out. This period of clonic convulsions lasts from two or three to twenty minutes.

The tonic convulsions are really much more dangerous to life; death may occur from asphyxia or serous or sanguineous effusion in the brain. But, says Barker, the clonic convulsions are much more frightful to the uneducated bystanders.

2. The *coma*. Insensibility has set in during the convulsion period. It continues for a variable time after the paroxysm, according generally to the severity of the convulsion. Sometimes it takes the form of heavy sleep, from which the patient wakes up, opens her eyes, and returns to self-consciousness and perception. What she has gone through she knows nothing of, excepting a dull recollection of the headache and vertigo which ushered in the fit. In other cases the patient may lie motionless, the extremities stretched out and flaccid, the respiration frequent and labored, at first stertorous, afterwards slower and snoring. Sometimes she is capable of being imperfectly aroused.

3. The *remission*. The respiration becomes more even and free, less rattling, and the pulse less frequent. After awaking, the patient generally complains of a confused, dull headache, and great languor, which continue until a renewal of restlessness, stretching, slow tremulous bending of the arms, twitching of the facial muscles with reddening of the face announce a new paroxysm. Soon after the passing off of the coma, a remarkable condition of the nervous system may be observed. This consists in a renewal of nervous excitability, as when clouds are gathering for another storm. At this stage so intense is the diastaltic irritability that the slightest emotional, or peripheral irritation, whether arising from the uterus, as when a labor-pain begins, or from attempting to swallow, or from undue restraint applied to her limbs, or sometimes even a loud voice or other sounds, even the jar caused by walking across the room, a shake of the bed, may provoke a convulsion. Dr. Townsend relates[1] a case in which, when the hair was being cut, every stroke of the scissors caused twitching of the muscles. At this time also touching the vulva, vagina, or os uteri, for examination, or the passing the catheter may easily start a convulsion. Dashing cold water on the face, a blister to the nape or to the calves—popular remedies, sometimes even accepted by physicians—act in like manner. At this stage, the highest art is exerted by securing absolute repose. "Masterly inaction" here finds its legitimate application. The one active thing to do, is to lessen the irritability by the inhalation of chloroform.

The condition described closely resembles the tetanoid state induced in the frog by strychnine. On seeing convulsion excited by some of the causes

[1] Dubl. Quart. Journ. of Med., 1871.

specified we have been forcibly reminded of experiments in which we assisted Dr. Marshall Hall. A strychnized frog lay motionless, and recovered if not disturbed. Strychnized again, there was no convulsion so long as perfect repose was secured; but a prick on the skin, a shake of the table, would instantly provoke a paroxysm; and if a succession of fits was induced, the frog would die of a dose which would be innocuous under repose. The application of this to practice is obvious. We shall recur to it when discussing the treatment.

The interval of calm before another storm is of variable duration. Its length depends a great deal upon the freedom from irritation. There can be no doubt that each recurring fit is a heavy blow and shock dealt to the nervous centres, depressing the heart, and threatening life with accumulating force. One fit, even several fits, may be followed by recovery. But certainly the danger to life increases in an accelerating ratio with every fit.

In the more severe cases the convulsions recur with shorter intermissions; the coma is more prolonged, or scarcely remits; the breathing becomes more stertorous; the interval of calm is lost; convulsion and coma run together; and this state but too frequently ends in death.

Are there any *forewarning symptoms* to tell the physician what is coming, and to furnish indications for averting the threatening danger?

In some cases the convulsion attacks suddenly; the patient and her friends have no suspicion of anything wrong; the physician has no opportunity of seeing her before the storm has burst. It is more than probable that, even in such cases, scientific observation instituted beforehand would detect signals of danger. Thus, to anticipate the discussion of the pathology of the affection, we may state that in one class of cases convulsions break out in women whose urine showed albumen beforehand, and that in another class there is no antecedent albuminuria. To take the first class, the albuminuric cases. In these the albuminuria is commonly attended by anasarca; the elective seats of the effusion are the face, especially under the eyes, giving a bloated aspect; the hands, so that rings become tight, and the feet swell so that boots are ill-borne. In some cases the dropsical effusion is all but universal. Ascites may be so extensive as to conceal the uterus from touch; the pericardium and pleuræ are also filled; the connective tissue of the lungs is invaded, and the brain does not escape. These cases are commonly fatal. No function can be efficiently carried on where the whole system is waterlogged. These conditions are objective, and can hardly escape notice. Whenever they are seen, the urine should be immediately tested for albumen. If this is found—and its presence may be confidently predicated—further evidence is hardly necessary. But there will rarely be wanting certain subjective signs, by themselves too significant to be disregarded, and, when added to the objective signs, forming a compact and irresistible body of evidence. These are: headache, sometimes dull and continuous, sometimes throbbing; vertigo, a feeling of syncope; impairment of sight, temporary perhaps at first, afterwards becoming permanent. This may be confirmed by objective examination. The ophthalmoscope may reveal haziness of the fundus of the eye, the papilla swollen, the retinal veins enlarged, and very probably some hemorrhagic effusions in the retina.

Ringing or buzzing in the ears, difficulty of articulation, nervousness, a sense of terror, irritability of temper, difficulty in finding the proper words to express the thoughts, are further subjective signs, also more or less open to objective perception. Aphasia is a not uncommon forerunner of convulsion.

The cases in which albuminuria does not precede the convulsion are much more difficult, and generally baffle forejudgment. Nothing short of a sys-

tematic and frequently repeated examination of the patient throughout pregnancy can avail. Thus, watching for the first steps of the deviation from the strictly physiological path, we may hope to have timely warning. In these cases the objective signs described may be wanting; the subjective signs, also, may fail to arrest the attention of the patient. The fact seems to be that, under the blood-and-nerve conditions present leading to the development of danger, the patient's self-perception is apt to be dulled. Dr. Mahomed has, in memoirs[1] of great scientific and clinical value, pointed out that there is a pre-albuminuric stage, in which clear evidence can be elicited of the advent of albumen in the urine. This state is proved to be a first or premonitory stage of the affection produced by the action of the same causes. The crystallizable principles of the blood transude into the uriniferous tubules before the albumen. This he proves by *Mahomed's test.* A small slip of white blotting-paper is dipped in the urine and dried over the flame of a spirit-lamp; by this means the dilute solution of the crystalloid is concentrated by evaporation; two drops of tincture of guaiacum are then dropped on the paper, and after a minute or so allowed to evaporate; a single drop of ozonic ether is let fall in the centre of the guaiacum stain. A quarter of an hour may elapse before the reaction becomes visible.

Sibson gives the following signs of high vascular tension: "Pulse hard, sustained; a forcible and sustained after-beat, prolongation of the first sound, a reduplication of this sound near the apex over the septum, whilst at the base the first sound is dull and indistinct, the second loud and clacking."

There are three signs of the high tension, with arterial pressure on the kidney, disposing to convulsion, with or without albuminuria: (1) The high-tension wave indicated by the sphygmograph; (2) the pulse and heart-beat as observed by auscultation; (3) Mahomed's test.

Where these signs concur the danger of convulsion is serious. But these signs become manifest only on examination *ad hoc.*

The further or ulterior consequences of albuminuria or convulsions. Where quick death or recovery does not take place, other phenomena appear. In the first place, *abortion or premature labor* is very likely to be provoked. The outbreak of convulsions, albuminuria being present, may be delayed until the natural advent of labor. But the irritation running from the uterus to the diastaltic centre, it is nevertheless true that, in the majority of instances, the convulsion sets in first. Then, the diastaltic function excited to an inordinate degree, the uterus—an organ physiologically predisposed to act—receives the impulse and enters into contraction, partly, probably, from the blood carried to it being highly charged with carbonic acid. The fact that convulsions frequently attack women at six, seven, or eight months of gestation is enough to show that labor is not the essential cause.

Where convulsions supervene upon albuminuria the gestation will rarely go on to term. If labor do not occur spontaneously, the physician should induce it as the best way of arresting the convulsions and the pathological process which produces them.

Puerperal phlegmasiæ of the cellular tissues and serous membranes are especially likely to occur. These will be described under the "Diseases of Puerpery." In this connection it may be stated as a general proposition that convulsions and albuminuria increase the disposition to, and the severity of, most of the diseases to which the puerpera is liable. Denman, Gooch, Collins, all refer to the frequency of abdominal inflammation.

Robert Lee[2] was one of the first to refer to *the state of the eye* in albuminuria.

[1] Medico-Chirurgical Trans., vol. lvii., 1874; Brit. Med. Journ., 1877.
[2] Med.-Chir. Trans., 1863.

Grenser[1] relates a case of convulsion breaking out soon after delivery; albuminuria; total blindness observed on returning consciousness. This disappeared in a fortnight. By ophthalmoscope under atropin, the veins were seen fuller, arteries empty; papilla nervi optici green; around it on the retina were insular gray turbid spots. The flame of a lamp induced no sense of light.

Spengler relates[2] a case of hemeralopia in a pregnant woman.

The subject of amaurosis in connection with the albuminuria of gestation is well illustrated by Fordyce Barker.[3]

Feeling the deep importance of this subject in its immediate clinical relations, as well as in its elucidating power applied to many problems in the physiology and pathology of gestation, we sought the aid of Mr. Power, whom we knew to have devoted careful attention to it. The following account of the affections of the eye observed in pregnancy is a contribution from Mr. Power:

He has seen a group of cases presenting characters in all respects identical with those that are characteristic of albuminuria. The optic disk was swollen and pinker than natural; its margins indistinct or altogether lost; the veins large and tortuous, sometimes varicose; the arteries less conspicuous; both sets of vessels covered with a thin veil of effusion as they traversed the region of the disk. The retina near the posterior pole of the eye presented hemorrhages and white patches, which were much fewer and smaller near the equator. The hemorrhages were generally irregular in form and dark, and the particular vessel from which the blood had escaped was sometimes recognized. In such cases the vessel sometimes terminated abruptly at the hemorrhage, or was only with difficulty traced beyond it, whilst in other cases the course of the vessel could be distinctly followed beyond the hemorrhage. In all the cases Power saw there were many hemorrhages, and so the sight being seriously affected the subjects sought advice; perhaps in other cases the sight not being much affected, and therefore advice not being sought, there might be fewer hemorrhages.

The white spots were identical with those seen in albuminuria. Like the hemorrhages, they were chiefly around the posterior pole, and were either in the form of irregular but rounded patches or of minute dots, and the fovea centralis was on several occasions surrounded by a corona of radiating dots and striæ. These, in fact, are the features seen in albuminuric retinitis. Power believes that in these cases albumen was either actually present in the urine, or had been so a very short time previously.

The hemorrhages and white patches, Power conceives, might be accounted for in part on the theory of over-distention of the vessels, the white glistening patches being due to such a degree of distention as allowed of white corpuscles, of which such patches are chiefly composed, escaping through the dilated stomata of the vessels; whilst the hemorrhages are the result of distentions pushed to actual rupture. This view is supported by the fact that most of these cases occur in the later months of pregnancy.

The affection is a serious one, for the rupture which takes place in the vessels of the eye might occur in those of the brain and spinal cord, which are under the same pressure. But Power, like ourselves and others, has seen recovery both of health and vision. We have, however, also known a fatal issue to follow on delivery.

Power describes another form of ophthalmic disease, the pathology of which is obscure, namely, *white atrophy of the optic disk*. This has arisen in

[1] Monatsschr. f. Geburtsk., 1866.
[2] Monatsschr. f. Geburtsk., 1865.
[3] The Puerperal Diseases, 1876.

cases where there had been great loss of blood; probably this had been preceded by optic neuritis. Possibly the arteries supplying the corpora quadrigemina and the corpora geniculata of the optic thalami, or those supplying the psychical centre of the brain, may spasmodically contract, or may be occluded by embola. He has seen a case in which vision, almost lost in a first confinement, was recovered to a great extent in a second.

One of the most frequent as well as most easily curable affections of the eye that occur in the later period of pregnancy and during lactation is impairment of the power of accommodation, which leads to minor disturbances of vision. The diminished power of accommodation is essentially due to exhaustion of the neuro-muscular apparatus of the eye. It is earliest seen and most strongly marked in those who are naturally hypermetropic. The symptoms complained of are: impossibility to read for more than a few minutes at a time, great fatigue in the eyes on attempting to sew or do fine work, the type or the threads running together; with a sense of dizziness and confusion in the head. If work or reading be discontinued, the eyes rubbed and the eyelids strongly closed, the feeling passes off, but the symptoms soon return on resuming work. Pain is experienced, black spots are seen floating before the eyes; these are not always subjective only but also objective, due to particles of pigment detached by strong pressure or friction from the ciliary region. The patient complains of redness and lacrymation, of the lids sticking together in the morning, and of inflammation along the margin of the lids. The whole chain of symptoms results from temporary failure in the power of accommodation. The patient makes violent efforts to bring the ciliary muscle into play, and both nerve and muscle soon become exhausted. The treatment is simple and effective. Convex glasses of low power, attention to the general health, steel and strychnia, are the main agents of cure.

Amaurosis may persist for weeks or months. This usually ends in recovery, provided, as we believe, there be no persisting albuminuria and degeneration of the kidney. We have witnessed complete recovery when there was not persistent albuminuria. Fordyce Barker relates several cases, and believes the prognosis is generally favorable.

The *Ear* lends itself less readily to observation than the eye. But it presents many points of great interest.

Sudden powerful emotions may cause deafness.

Mr. Dalby says that a young woman who, without any change in the middle or outer ear, becomes deaf during her first confinement, is pretty certain to be subject to an accession of deafness on every subsequent pregnancy, and will be in danger of increasing it infinitely if she nurse her children. This sums up very much of what we know concerning the ear in gestation. Deafness standing alone does not throw much light upon the gestation process.

The ear seems to be subject to the same laws as those which govern the eye in its relations to pregnancy. Deafness does not appear so frequently to be associated with albuminuria as is defect of vision.

Deafness has not been studied so carefully as amaurosis. The complication is not uncommon. Lever relates a case.[1] The deafness increased as pregnancy advanced. The hearing was better from day to day after delivery. She relapsed under suckling; and recovered under weaning and tonic treatment.

We know cases in which deafness recurs and becomes more marked in every succeeding gestation. In these the women have stated that the glands

[1] Guy's Hosp. Reports, 1847.

of the neck swelled simultaneously. We think this fact throws light upon the genesis of the affection. The tonsils swell with the other glands, and the mucous membrane of the Eustachian tubes thickening, it is easily understood that the hearing will be impaired, and how partial recovery takes place as the thickening subsides.

Cerebral apoplexy is an event to be dreaded. It is one of the most probable causes of death. This may take the form of serous or sanguineous effusion. If the patient survive, she may be left a sufferer from paralysis.

Pulmonary apoplexy is another probable event. Complicating asphyxia or occurring without it, it is an event of the gravest import.

One source of danger following albuminuria with œdema which has not attracted attention, is the sudden inpouring of the effused serum into the blood after delivery, when the tide is turned from high pressure and extravasation to low pressure and absorption. This is one source of danger of phlegmasiæ.

Mania is a not uncommon sequela of convulsions. During the mania the patient is sometimes destroyed. But if she survives, the mania commonly subsides in a few weeks, or earlier. Barker, who has had an exceptionally large experience in this field, says that mania follows puerperal convulsions in quite as large a number of cases where albuminuria has not existed, as in those where it has been present.

Hallucinations of sight especially are not uncommon during the immediate premonitory stage.

Paraplegia in gestation and puerpery is in many cases associated with albuminuria. Convulsions may or may not have occurred. Sometimes the only morbid condition that can be discovered is retroflexion of the subinvolved uterus.

Fordyce Barker cites a case, reported by Dr. Fourgeaud, of a lady who had several abortions and two children born prematurely. In the last pregnancy, seen a week before labor, the face was œdematous, she could scarcely see, she was delivered of a seven months' child, which had been dead apparently for three or four days. She had no convulsions, perhaps owing to the use of chloroform. Next morning she was found to be paraplegic; the motor power of both legs was entirely lost, sensibility partially impaired; there was paralysis of the rectum and sphincters, with involuntary discharge of feces, paralysis of bladder with retention of urine; and amaurosis, the sight being almost entirely gone. At the end of a year she had recovered.

Aphasia is occasionally observed. Barker records a unique case of a lady who, forty years before the report, had in her only labor severe convulsions followed by long-continued coma. Since that time she could only utter the words, "Oh, yes," through which, by various inflections of voice, she contrived to keep up intelligent intercourse with her intimates.

Aphonia, we ourselves have observed.

Disease of the kidney is especially to be apprehended. It is certain that in many—perhaps the majority of cases—the kidney is left intact. This is one of the striking examples of the light thrown by the study of gestation upon general pathology and the genesis of disease. A healthy kidney is suddenly called upon by an overwhelming pressure to perform more than its ordinary duty; it is unequal to the task; albumen filters through its structures in enormous quantities; still it preserves its structural integrity, and comes out of the ordeal unscathed. Like other observers, we have seen many instances of healthy young women who suffered severely from albuminuria and convulsions in their first pregnancy, and who enjoyed perfect health afterwards, bearing several children without any untoward complication.

On the other hand, all are not so fortunate. The kidneys may be permanently affected; and although, the gestation at an end, and its concomitant high vascular tension subsided, the albuminuria may be much moderated and the kidney may remain apparently stationary, no sooner does a new pregnancy occur than the disease is exacerbated, there is an increase of albumen, and if the pregnancy go on, the condition becomes more and more confirmed.

Pathology of Convulsions.—The most useful plan of studying the pathology of the disease, if not the most logical, will be next to trace the changes found in the body after death. Similar changes will not, indeed, necessarily arise in the early steps of the disease, nor in those patients who recover. Still we shall draw from this inquiry valuable facts to illustrate the phenomena observed in the living.

Braun describes the appearance with great exactness. The brain shows anæmia, œdema, diminished consistency. Hyperæmia of the membranes is rare. Intermeningeal apoplexy is rare. When it occurs it may, according to Kiwisch, be regarded as secondary, produced by impeded circulation of blood. Macdonald, in one case, found minute apoplectic extravasation in the corpora striata, a condition which has struck us forcibly in the watery state of the brain. In the lungs œdema is constant. The heart is commonly empty and flaccid. The spleen is large, as generally in gestation and childbed. Braun distinguishes three degrees of disease of the kidney. *First stage:* hyperæmia, at the commencement the surface is smooth, the capsule easily removed, the plexus of veins on the surface is dilated, full of blood. The cortical substance is brownish-red; from the surface of the section there flows a sticky bloody fluid, with which the parenchyma is infiltrated. The pyramidal masses are also hyperæmic, injection-striped. The mucous membrane of the pelvis and infundibula is swollen, covered with vascular arborescence; hemorrhagic effusion is frequently observed. The epithelium of the tubuli uriniferi is not essentially altered, but is easily separable. The tubuli, filled with coagulated or fluid exudation, sometimes contain blood-corpuscles.

In the *second stage*, that of exudation and of commencing fatty metamorphosis, the cortical substance is of a dull yellow, the striped vascular ramifications and red spots in it disappear. The organ is bulky, much exceeding the normal weight. It then gets softer, more friable, milky and dark. The surface is sometimes smooth, sometimes granulated, covered with elevations of the size of a poppy-seed. The capsule is easily separated; the pyramidal masses dark-red. The infundibula show a dirty-red mucous surface. Between glomeruli and capsule lies a thick stratum of firm exudation of granular structure, showing fat-droplets. The interior of the epithelial cells of the tubuli is, in extreme cases, filled with fat-droplets, becomes turbid, and at last the cells themselves are decomposed into aggregations of granules.

The *third stage*, that of retrogression and dissolution of the glandular substance (atrophy). The kidney becomes smaller. The capsule is dirty-white, thickened in parts, closely united to the cortical substance. The surface is uneven, tuberculated. Similar conditions are described in a series of cases by Krassing,[1] and they are confirmed by other observers.

Dickinson[2] says the morbid changes in the kidney are "such as obstructive or venous congestion would be apt to produce. They are allied to those which occur as the result of heart disease with attendant venous repletion. They may be epitomized as congestion succeeded by excessive growth of

[1] Monatsschr. f. Geburtsk., 1860.
[2] Pathology and Treatment of Albuminuria, 2d ed.

epithelium, interstitial nucleation, fibrosis, and granulation. But when of uterine origin it is to be observed that, partly, perhaps, by reason of the susceptibility of the subjects, it is more mischievous than when it is cardiac. Both undergo at first increase of epithelium and ultimately of fibrous tissue, both become at last granular. But the cardiac kidney is usually to the last red, hard, and free from oil, while that of uterine origin often becomes fawn-colored and fatty."

Depaul,[1] in a report on a memoir by Dr. Mascarel, stated that in the autopsies he had made, the kidneys were perfectly healthy, or simply congested.

We may now usefully discuss the various theories put forth as to the pathology and etiology. The first theory in order of time is the pressure theory started by Lever. It was adopted by Rayer, Litzmann, Caseaux. It still finds many adherents. This theory rests mainly upon the assumed compression of the renal arteries and veins by the gravid uterus. The arguments urged in support are—(1) the comparative frequency in primigravidæ, in whom the abdominal walls being firmer, press the uterus backward against the spine more forcibly; (2) the occurrence of œdema and venectasis of the lower extremities, pointing to pressure upon the vena cava: the inferior mechanical venous hyperæmia of De Cristoforis; (3) the greater frequency when the uterus is of excessive size from twins or liquor amnii.

Professor Halbertsma[2] urges the pressure-theory in another form. He contends that the kidney suffers through *compression of the ureters* by the gravid uterus. Löhlein[3] adopts this view, saying that he found dilatation of one or both ureters in 25 per cent. of the deaths from puerperal eclampsia, and in 3 per cent. only of deaths from other causes.

Against the general theory strong facts are in evidence—(1) the pressure is not adequate. As the uterus rises from the pelvis, it diverges from the spinal column, leaving the kidneys and their vessels protected in the receding lumbo-dorsal region; at most there is pressure upon the common iliac veins and the lower part of the vena cava; (2) albumen sometimes makes its appearance at the third or fourth month, before the uterus can possibly press upon the kidney or its vessels; (3) the albumen may disappear under treatment by purging or bleeding, although the uterus continues to grow (Robert Barnes); (4) albuminuria and convulsions not seldom occur in pluriparæ, though escaped in the first pregnancy; (5) the greater frequency in cases of distention from twins may be more reasonably explained by the greater nervous and vascular tension induced by the double demand, and by the greater amount of excrementitious stuff thrown into the circulation.

These facts are not so conclusive against Halbertsma's theory of special pressure upon the ureters. Still, even here it may be objected that pressure upon the ureters will hardly account for eclampsia in the third and fourth months of gestation.

Another theory is that the convulsions are caused by *labor-pains*. Undoubtedly this is occasionally true as regards the convulsions. Indeed, labor itself may be regarded as a physiological convulsion. It, however, fails to account for the albuminuria. When the albuminuria already exists, then, as we have seen, uterine action may be the immediate cause of convulsion. Often albuminuria and convulsions both occur without any sign of labor. Braun, however, says that of 44 cases of eclampsia seen by him, it broke out 24 times during labor and 8 times in puerpery. Wegscheider collected 435 cases; of these, 236 cases broke out during pains, 109 before

[1] L'Union Médicale, 1854.
[2] Trans. Intern. Med. Congress, 1881.
[3] Deutsche Med. Zeitung, 1883.

and 110 after labor. Von Wieger has tabulated 455 cases; the convulsions preceded the commencement of labor in 109, attended labor in 236, and followed labor in 110. The tables of these authors probably contain many cases in common. Here, as so often occurs when statistics are invoked, the necessary analysis of the cases is baffled. It cannot be doubted that in many instances the labor was premature, probably provoked by the conditions leading to albuminuria and convulsion. It may be admitted that in many cases the outbreak was immediately excited by the uterine contractions or by some other irritation proceeding from the uterus. The nervous tension has attained its acme at the time for labor, and will naturally respond to slighter irritation. Braxton Hicks[1] brought forward a memoir "On the Behavior of the Uterus in Puerperal Eclampsia." In two cases he noted that, coincidently with a convulsion, a powerful and prolonged contraction of the uterus occurred.

Analyzing the histories of 55 cases of puerperal eclampsia, of which Robert Barnes has preserved notes, we find that in 18 the convulsions broke out without any antecedent sign of labor; labor being either an epiphenomenon caused by the convulsion or induced by the physician. It is scarcely probable if eclampsia break out for the pregnancy to go on. One of two things will almost certainly happen—(1) if not delivered, the cause of the toxæmia persisting, the convulsions will be continued, and prove fatal by exhausting the sufferer by shock, or by direct lesion of the brain; or (2) labor will be induced by the circulation or stagnation in the nervous centres and uterus of blood charged with carbonic acid. Such blood acts, as Marshall Hall and Brown-Séquard have shown, as a direct stimulant to muscular contraction. When black blood is circulating, uterine action begins. Once started, the nerve-storm seizes the uterus as well as the voluntary muscles; the sphincters then relax, the os uteri dilates, and the labor proceeds.

Gübler's *theory of superalbuminosis*.[2] This supposes that the disease depends upon the elimination of an excess of albumen which the pregnant woman's blood contains. If the proportion of albumen exceeds the normal wants of the mother and fœtus, the excess must accumulate in the blood and be eliminated by the kidneys, as is observed in animals fed exclusively on albumen, or in whose veins a solution of albumen is injected. The kidney, therefore, is not primarily diseased, but serves as a filter. This hypothesis contains a part of the truth. Allied to this theory is that of Peter,[3] who suggests that there is "transudation of albumen," and "autotyphlization."

Caseaux, dwelling upon the pressure-theory to account for the albuminuria, attributes the disease to a *serous plethora*, a condition observed in chlorosis and gestation, producing greater tension of the whole vascular system. This contains a part of the truth. The theory of anæmia is allied. But the convulsion of anæmia from hemorrhage differs from that of albuminuric eclampsia. It precedes death; it is the sign of "agony." It is preceded by general tremor, a kind of universal shuddering; consciousness is not always abolished, and there is no trachelismus or congestion of the face. There is often vomiting, and the pulse is rapid or even imperceptible. These signs make up a picture quite distinct from convulsions.

Temporary or Permanent Disease of the Kidney.—This theory received the sanction of Bach, Imbert, Goubeyre, Litzmann, Frerichs, and Braun. The conclusive objection is the complete recovery which in many cases follows.

We have already cited Braun's description of the lesions found in the kidney. These, it must be remembered, are conditions found in fatal cases.

[1] Obstetr. Soc., 1883. [2] Dict. Encyclopéd. des Sciences Méd.
[3] Archives de Tocologie, 1875.

They are far from proving that like changes are necessary to the initiation of the albuminuria or of the convulsions. In his second and third degrees of Bright's disease, it is indeed highly probable that had the patients survived they would have suffered from more or less prolonged albuminuria. Dr. Southey in an excellent clinical lecture[1] describes the condition under the name of "pregnancy nephritis." But we much doubt whether the first degree is really more than extreme hyperæmia. Here we venture to set forth an explanation of the *néphrite albumineuse* of Rayer, and of the acute desquamative nephritis of recent English authors, which we believe has not hitherto been suspected. If we examine the cervix uteri and vagina during pregnancy by the eye, we see intense hyperæmia and the surface covered with creamy discharge. This consists of epithelial scales shed under the intense physiological hyperæmia; these scales are in fatty degeneration; they are suspended in an albuminous plasma. A similar condition is often found in the other parts of the mucous tracts open to direct observation. It is in the highest degree probable that the mucous membrane of the glandular structure of the kidney, an organ specially within the range of the high vascular tension, and liable to constant irritation by waste-stuff brought to it for elimination, suffers in like manner. We infer from this that no structural lesion of the kidney is necessary. The kidney conditions attending the initiatory stages of albuminuria and convulsions are nothing more than the result of the high vascular tension which tells upon the whole mucous tract. This theory is in harmony with Mahomed's observations on the pre-albuminuric stage, and the clinical history of albuminuria in scarlatina, in which disease there are high tension, intense congestion of the mucous membrane, and an irritating poison in the blood. Depaul, we have seen, found the kidneys healthy.

The following passage from Warburton Begbie is in point. "What is the cause of the albuminuria in simple scarlatina, and what is its pathological import? I conceive it to be as essential a symptom of the disease as is desquamation of the cuticle; to be, in fact, the result of a desquamative process, which the mucous membranes in this disease equally with the skin are subject to. Granted then that the desquamation occurs when such a change is taking place in the epithelial membrane lining the minute tubes of the kidney, the office of the cells composing which is to eliminate from the blood the matters solid or fluid which in the normal exercise of the renal function compose the urine, it surely is not surprising that the albumen from the former should to a slight amount enter into the latter. It indicates the separation of epithelial cells and their passage into the current of the blood."

We have presupposed *toxæmia as a factor*. What is the poison? It is impossible to give a precise answer to this question. 1. There is the *theory of uræmia*.

That urea is found in excessive proportion in the blood in the albuminuria and eclampsia of gravidæ is well attested. Gegenbauer and George Harley were amongst the first to attest it. Robert Barnes having bled a patient, had the blood analyzed by Professor Bernays, who found urea and uric acid in it.

A correlated fact is, that urea is found in diminished quantity in the urine. But do these facts prove that the urea is poisonous? Claude Bernard showed that injections of large doses into the veins caused no convulsion, and Chalvet and Gallois say that, far from being a poison, it is a valuable diuretic.

[1] Lancet, 1883.

Lehmann found that chlorides almost disappear from the urine as in other diseases attended by abundant exudation.

2. The *ammonæmia theory of Frerichs* assumes that the urea is oxidized, forming carbonate of ammonia. But no analysis has shown this decomposition in the blood. Richardson, J. Dumas, and others have shown that ammonia is a normal constituent of the blood. Hammond rejects Frerichs's theory. Jaksch, in a valuable clinical analysis,[1] shows that in true ammonæmia, such as arises from decomposition of urine in the bladder and absorption, the symptoms are altogether different from those of puerperal eclampsia. Rosenstein also argues against both the uræmic and the ammonæmic theories.[2] Certainly these hypotheses are not necessary to explain the convulsion. Monck injected carbonate of ammonia into a dog, having first tied the ureters. The dog did not suffer.

3. Rosenstein dwells upon *anæmia and œdema* of the brain. Monck again tied the ureters in a dog, and injected water into the carotid. Convulsions and coma ensued. As in Bright's disease, anæmia and œdema of the brain were found on dissection.

4. Schottin surmised that *the extractive matters* of the urine formed the poisonous element.

5. In the absence of precise chemical evidence we prefer the general term of *urinæmia*. That the kidneys fail to eliminate the waste-stuff of nutrition is certain; that this accumulates in the blood is a necessary consequence; that absorption of urine and failure of the kidney to do its duty lead to empoisonment and convulsion is a familiar clinical fact illustrated not alone in obstetric practice, but in general surgery and medicine.

6. A *material alteration of the nervous centres or of their membranes.* The objections to this theory are: 1. That the lesions found after death, however they might have been the cause of death, were most probably the result of the conditions which caused the albuminuria and the convulsions. 2. The lesions found do not bear especially on those parts which physiologists show to be the only ones capable of determining convulsions, namely, the spinal cord, the medulla oblongata, the corpora quadrigemina. Congestion or anæmia of the brain and its membranes which attend the anasarca of some albuminuric women do not produce excess of activity or disorder of movement. 3. The lesions accused are not constantly found. 4. This theory fails to account for the cases that recover.

Frerichs and Blot observed that subjects much infiltrated appeared less disposed to convulsions than those in whom there was little or no œdema. It is true, at least, that there is no certain relation between the convulsions and the extent of anasarca.

We are driven to conclude that it is not with eclampsia, as Voisin and others hold to be the case with chorea and epilepsy—that is, the visible alterations found in the brain and cord in persons who have died of epilepsy and chorea, are consecutive upon, not antecedent to, the disease. These structural alterations are more strictly connected with the ulterior superadded symptoms of the disease than with the initiatory or proper symptoms. For example, when the disease has long endured, when the fits have become frequent and severe, the brain commonly shows signs of impairment, and exhaustion, paralysis, dementia or mania is the result. In his memoir on chorea,[3] Robert Barnes adduced reasons for concluding that the graver symptoms—the paralysis, the mania, death—were produced by the repeated shocks of convulsion. In the cases of tetanus, perhaps also of strychnism, it

[1] Vierteljahrsschr. f. d. prakt. Heilkunde, 1860.
[2] Monatsschr. f. Geburtsk., 1864. [3] Obstet. Trans., 1868.

can scarcely be doubted that the fatal prostration is almost purely the result of the repeated shocks.

We have seen almost sudden death in labor which could be ascribed to no other cause than the shock of pain and the convulsive action of the uterus. In some cases of paraplegia arising in labor it seems reasonable to attribute the paralysis to exhaustion or to shock upon the spinal cord.

It is greatly by the influence of shock that we must explain the cerebral disorder which so often attends the progress of puerperal convulsions, of epilepsy, and of chorea. The fits act as repeated shocks which stun the nervous centres. These shocks are equivalent to concussions. The *ictus epilepticus* is as real a blow as the apoplectic stroke. Both exhaust and divert the nervous force, and after a time impair the nutrition of the nervous substance.

In the case of chorea proceeding to mania we have to note that the cerebral disease is almost always *secondary and progressive.*

In cases of puerperal mania breaking out after labor, where there has been no convulsion, it may seem that some other factor than shock must be invoked. In some of these there is albuminuria; that is, blood-poisoning. But in other cases there is neither convulsion nor albuminuria. But in all there is the shock of labor, with its attendant exhaustion, its severe physical and psychical revolution, and the blood-degradation of puerpery, acting upon a nervous system wrought up to a climax of irritability. It would seem that convulsions, collapse, insanity are not indeed interchangeable, but that the issue in any one of these is determined by idiosyncrasy, by diathesis, or by some preëxisting peculiarity in the nervous centres.

Tyler Smith enunciated the theory that the albuminuria "*may depend upon sympathetic irritation of the kidneys* by the gravid uterus, similar with the irritation of the salivary glands, the mammæ, the thyroid, etc., and not upon mere pressure." Frankenhaüser reasons against the pressure-theory, and applying his discovery of a direct connection between the nerves of the uterus and the renal ganglia, suggests that the nervous system and not the vascular system is the starting point of puerperal convulsions; he also bases his theory upon the occurrence of eclamptic fits where no albuminuria existed.

Rosenstein, extending the theory of Traube, submits that eclampsia, like the starting of nervous symptoms in ordinary uræmia, supervenes when, in a very hydræmic person, the pressure in the aortal system is suddenly raised; then there is formed in the brain an acute œdema, the effused serum compresses the cerebral vessels, and hence there arises acute anæmia of the brain. When this condition affects the cerebrum only, coma ensues; if it seizes the middle convolutions, convulsions break out. This theory seems plausible; but it is inadequate.

The observations of Bourneville throw useful light upon the pathology, prognosis, and treatment. He studied the changes of *temperature connected with eclampsia.* Nine observations[1] lead to the conclusions: 1. That during the eclamptic fit the temperature rises from the beginning to the end; 2, in the intervals, the temperature remains high, and, at the moment of convulsions, there is a slight rise; 3, if the fit is to end in death, the temperature continues to rise 41°–42°, and reaches a high figure; at the moment of death it may reach 43°. If, on the contrary, the fits subside, and coma diminishes or ceases distinctly, the temperature falls progressively and returns to the normal degree. In ordinary uræmia, on the other hand, the temperature falls.

[1] Bourneville, Etudes Cliniques et Thermométriques (Urémie et Eclampsie Puerpérale), 1874.

We must now discuss a very important question, What is *the connection between albuminuria and eclampsia?* We have already stated the two facts that eclampsia sometimes breaks out without albuminuria, and that albuminuria may exist without eclampsia ensuing. There is a third fact well-established. The eclampsia is sometimes so quickly followed by albuminuria that the eclampsia seems to cause the albuminuria. We must commence by clearing away a possible source of fallacy. Litzmann showed that albumen is occasionally found in the urine of puerperæ as the result of catarrh of the bladder due to pus-globules.

Depaul, Legroux, Lévy, Braxton Hicks, Fordyce Barker, and others attest the fact that albuminuria occasionally follows upon the eclampsia. Casati relates a clear case.[1] It is necessary to distinguish cases of simple epilepsy which are a revival of a latent epileptic diathesis, and which are not connected with albuminuria. The argument of the authorities cited does not rest upon cases of this kind, but upon cases of pure eclampsia; although Hicks affirms that albumen is observed in epileptics, the epileptic fit is far from being frequently the cause of albuminuria. Thus Dr. Gibson[2] repeatedly examined the urine of three epileptics during and in relation to the fits. He says sugar and albumen were always absent. Urea was somewhat above the average; chloride of sodium much below. Althaus examined the urine of epileptics after a long series of attacks and found no albumen. Hicks's account calls for quotation:

"A woman approaching the full period of pregnancy, apparently in perfect health, without albumen in the urine, is suddenly seized with an epileptiform attack. After a certain time, albumen is noticed in the urine, at first in small quantities, shortly in profusion; then blood-globules, waxy and epithelial casts, are found in it. The urine becomes scanty, of high specific gravity, with very high-colored crystals of lithic acid in considerable quantity. The case, which is now one of acute desquamative nephritis, may terminate by gradual recovery, the albumen slowly disappearing; or death may ensue from the violent effects of the original attack, or from the retention of urea, etc., in the system in consequence of the acute mischief in the kidneys." He thence argues that: "1, the convulsions themselves are the cause of the nephritis; 2, that the convulsions and the nephritis are produced by the same cause; *e. g.*, some detrimental ingredient circulating in the blood, irritating both the cerebro-spinal system and other organs at the same time; 3, that the highly congested state of the venous system which is produced by the spasm of the glottis in eclampsia is able to produce the kidney complication."

Accepting the facts of Depaul, Hicks, and others cited we submit that they have only a limited application to the solution of the problem. If some cases of eclampsia occur, not preceded by albuminuria, but followed by it, it is nevertheless true that in a much larger proportion the albuminuria precedes, or at any rate is found abundantly, not after twenty-four hours, but at the time of the first fit. We must, then, seek further back than the fit for the cause of the albumen. The most philosophical explanation appears to be that the high vascular tension telling upon the kidneys impairs their working powers; and that from this cause, and from the accumulation of noxious stuff, the proceeds of the double nutrition of mother and fœtus, there ensue two things: irritation of the kidney and irritation of the cerebro-spinal centres. The researches of Mahomed go far to explain the occasional precedence of the fit, over the albuminuria, by showing that the kidney is already laboring in the pre-albuminuric period. These researches and the

[1] Annali Universali di Medicina, 1868.

[2] Med.-Chir. Trans., 1867.

facts observed are further in harmony with the views of Gull and Sutton, which imply that arterial fibrosis and hypertrophy of the heart react upon the kidney in causing Bright's disease. The hypertrophy of the heart is a constant condition in gestation associated with the high tension, and the consequent fulness and tension of the small arteries carry the analogy still closer.

One circumstance that lends weight to this view is the increased liability to convulsion at the menstrual epochs, when the nervous and vascular tension is increased.

The tension falls when the child dies in utero. Spiegelberg even relates a case in which the albuminuria and convulsions ceased on the death of an extrauterine fœtus.

Analogy with Bright's disease, the acute dropsy from cold, from scarlatina and similar conditions, throws a strong light upon the acute albuminuria and convulsions of gestation. In all these cases we also find deteriorated blood, impeded excretion, and high vascular tension. Then there are the researches of Mahomed, which prove that under high vascular tension the kidney is struggling before albumen exudes. We may from these clinical facts construct a strong hypothesis. There is the strong predisposition to exaggerated diastaltic action, increased by the imperfect nutrition of the nerve-centres; all that is wanted to overthrow the balance is an exciting cause; this is found in the noxious stuff retained in the blood through imperfect excretion; this, irritating the diastaltic centre, provokes the convulsion.

Author's Theory.—Several conditions concur to cause the associated disorders. These are: (1) The hydræmic state of gestation leading to imperfect nutrition of the nervous centres, increasing (2) the normal nervous tension and irritability, and (3) the normal vascular tension; with these comes (4) blood-poisoning from imperfect elimination of waste-stuff by the kidneys and other emunctories.

This view, set forth in Robert Barnes's Lumleian Lectures, 1873, is advocated by Hypolite, 1879.[1]

THE PROGNOSIS.—The account given of the symptoms and issues of the affection will supply the materials for a prognosis. The question is threefold: 1. Will the patient recover? 2. Will the gestation be brought on to an end? 3. Will she recover completely, or with damaged kidneys? Then there is a fourth question as to the fate of the child.

Hypolite says eclampsia breaking out during labor is much less severe than when it breaks out during gestation. It tends to disappear as soon as the gestation is ended. A rising temperature with frequent fits, prolonged coma, especially if continuing after delivery, dictate a grave prognosis; the opposite conditions, especially if attended by lessening quantity of albumen, justify a favorable prognosis.

He says, further, that eclampsia is attended by febrile reaction, and therefore by rise of temperature. This continues to rise or to fall progressively, according to the unfavorable or favorable issue, as Bourneville also showed.

The risk of convulsion is less when the albuminuria and attendant blood-poisoning assume the chronic character. In cases of albuminuria dependent upon chronic Bright's disease the pregnancy aggravates the affection. It has appeared to us that the convulsion is less likely to ensue than in the rapidly produced acute albuminuria. In chronic Bright's disease a process of accommodation takes place, whilst in acute albuminuria the nervous centres, suddenly invaded by poisoned blood, are unprepared for resistance.

[1] De l'Eclampsie puerpérale. Paris, 1879.

Barker puts and answers the question, *In which period is the occurrence of convulsion the most dangerous?* Eighteen years ago he published a table of cases collected from all sources, from which it appeared that 32 per cent. of all cases which occurred before and during labor, and 22 per cent. of those that occurred after delivery, ended fatally. Since then Barker observes that the disease is better known, and therapeusis improved, and we may expect more favorable results. He states elsewhere his conviction that the use of chloroform would diminish the mortality by at least 50 per cent. Dohrn analyzed 747 cases; these gave a mortality of 29 per cent.

THE EFFECT UPON THE CHILD.—In some instances the fœtus seems to be affected by the poison circulating in the maternal blood. Children are born dead in larger proportion than under ordinary circumstances. In the case of convulsions breaking out at term during labor, the prospect of the child is at the best. This consideration may weigh when discussing the question of inducing labor.

That the fœtus is frequently expelled dead by abortion is certain. It is highly probable that the death is due to the slow asphyxia by degradation of the maternal blood. But a large proportion of children are lost during the labor, especially if it be premature and artificially hurried.

Sometimes the child in utero seems to be convulsed. A deeply interesting cases is related by Dr. James Whitehead.[1] He felt the child convulsed at the same time as the mother.

A point to be noted is the not infrequent complication of albuminuria and convulsions with hydatidiform degeneration of the chorion. In such a case there should be no hesitation in emptying the uterus.

THE TREATMENT.—The principles of treatment flow logically from the views we have taken of the etiology and nature of the disease. Four cardinal principles stand out for our guidance:

1. To moderate and control nervous irritability.
2. To moderate vascular tension.
3. To cut off emotional and peripheral irritants or excitants.
4. To eliminate all complicating morbid conditions.

The treatment is (1) prophylactic, (2) remedial, (3) restorative. 1. The *prophylactic treatment* applies to two states: first, to the preservation of the healthy condition of gestation, to the pre-albuminuric stage; and, secondly, to the albuminuric stage, with a view to avert eclampsia. 2. The *remedial* treatment applies to the moderation of the fit and its effects. 3. The *restorative* treatment applies to the restoration of the equilibrium of the system and of the kidneys and other organs to their normal state.

1. *The Prophylaxis.*—The general principles laid down for the care of the gravida apply: exercise, moderate diet, sparing use of stimulants, great care in regulating the secretions, baths to keep the skin, the great alternative organ of the kidneys, in healthy action; testing the urine, watching the pulse by sphygmograph, and the state of the nervous system, to detect early notice of excess of tension, and, in this case, to give salines and digitalis. The hydræmic condition, also, is an indication for the administration of iron. Small doses of the sesquichloride or sesquinitrate we have found extremely useful.

Perhaps the greatest of all prophylactic remedies in the albuminuric stage —saving the induction of labor, to be presently discussed—is absolute rest, including under this term the removal of every source of mental, emotional, or physical disturbance. The attendants should avoid all force or loud speaking. The clothes should be so opened as to give free play to the lungs.

[1] Brit. Med. Journ., 1867.

A golden rule we insist upon as of the last importance is, *in any case where a fit is probable, to make no examination, not to pass the catheter, and to force no food or medicine, until the patient is under the influence of chloroform.* The slightest disturbance, especially touching the genitals, may provoke a fit, whereas all necessary manipulation can be readily carried out under anæsthesia. Under the same indication, avoid blisters, at one time a routine practice, and still, we fear, resorted to. We have seen the first effect to be the provocation of a fit. They cannot possibly do good. They are almost certain to do harm. The cantharidine, moreover, irritates the kidney.

In the pre-albuminuric stage, especially to give salines and digitalis, and saline purgatives, elaterium, calomel, or podophyllin or jalap. If vertigo, flushing, red face, disturbance of sight appear, bleeding to twelve ounces, twelve leeches to the temples, or cupping in the loins, may avert mischief to kidney and brain.

Before resorting to the induction of labor, it may be useful to try Copeman's method of dilating the cervix uteri, under chloroform, of course.

Prophylaxis in the *albuminuric or pre eclamptic stage.* The preceding rules apply. In addition, we have a resource in the milk diet advised by Tarnier.[1] This consists in putting the patient on an exclusive milk diet; of this she may take as much as she likes. Chantreuil relates a striking case in which there were extensive anasarca, œdema of the lungs causing suffocating attacks of dyspnœa, which in a fortnight were quite subdued by a bleeding and the absolute milk diet. She was delivered without having suffered from eclampsia.

2. *The Remedial Treatment. How to Treat the Fits.*—The first question—one too much neglected of late years—is that of venesection. At one time it was in great vogue, and was, no doubt, abused. It is undoubtedly the most powerful and prompt resource at command for lowering the high vascular tension—a primary cause of the eclampsia. Hall Davis advocates it in sthenic cases. Richardson extols it in uræmia when the temperature is raised, and this, Hypolite says, it always is. Fordyce Barker and Scanzoni practise it. Chantreuil relates cases of successful application. We ourselves are clear as to the advantage derived from it. There are three ways of bleeding: venesection, leeches, cupping. Each, under certain conditions, may have its advantages. Against bleeding an apparently strong case has been made. Comparative statistics, showing more recoveries under chloroform than under bleeding, are adduced. Thus Charpentier,[2] analyzing 133 cases observed under Depaul, found a mortality of 45 per cent.; under bleeding (single), 41 per cent.; under repeated bleedings the deaths were 54 per cent.; under anæsthetics, 84 cases gave a mortality of only 18 per cent. There may be a fallacy underlying these statistics. The cases may not have been of equal severity, and they may not have been comparable in other points. The Traube-Rosenstein theory seems to explain the deleterious action of bleeding. Schrœder puts it that the sudden depletion of the vascular system, by diminishing the arterial pressure, will stop the fits. But after bleeding the quantity of blood soon becomes as great as before from the absorption of effused serum. Now this involves deterioration in quality of the blood; it is made more defective in red globules. Abstraction of blood then would first do good; but soon the arterial tension will return, and the state is worse than before. If the temperature is falling and the fits are becoming less severe, bleeding should not be resorted to. It is assumed by some that chloroform must displace bleeding. It is one of

[1] Tarnier, Progrès Médical, 1875; Leçons cliniques, du Dr. Chantreuil, 1881.
[2] Thèse de Concours. Paris, 1872.

the great errors of modern medicine, in taking up a new remedy straightway to discard the old. Bleeding may be of occasional value; but in the great majority of cases it must yield to chloroform.

The next class of remedies adapted to fulfil the indication of lowering vascular tension is purgation. Elaterium, calomel, croton oil, salines, by producing watery evacuations, reduce the blood-mass and allay vascular tension. The croton oil is especially valuable, because a drop or two can be put upon the tongue when the patient refuses to swallow.

Then there are certain sedatives which moderate nervous tension as well as vascular excitement. Amongst these are chloral, which may be administered by enema; but this should not be carried beyond one dose of twenty or thirty grains. It is dangerous to repeat it within it a few hours. There is a general consensus now in favor of chloroform inhalation. Nor is it possible to speak too highly of it. It is prophylactic and remedial. Used during the fit, it shortens the attack. Watching for the premonitory signs of a fit, as the facial twitchings and restlessness, and, then given, the fit may commonly be averted, certainly mitigated. Thus, if time is gained for labor to be completed, the patient is carried over the critical stage. In this way chloroform may be freely but discreetly given during many hours.

Chloroform blots out memory, one source of emotion; it shuts out perception, another source of emotion; it lessens reflex irritability. It further acts in averting or shortening a fit by inducing asphyxia in a modified form, in the same way as Achille Foville represents a fit of epilepsy as ceasing under the effect of the asphyxia which itself produced.

Closely allied to chloroform in its *modus operandi* is nitrite of amyl. Robert Barnes had the good fortune to cure a severe case of strychnism by the persevering use of this remedy, and advised it in all cases in which it is desirable to relax muscular spasm.

A successful case has been reported. Robert Barnes advised its use in his Lumleian Lectures in 1873.

The *nitro-glycerine* is extremely promising as a resource. Mr. Green reports a case.[1] The patient took 1♏ every hour. It was given after labor, and, therefore, when there was a natural tendency for the symptoms to subside. Lately Drs. Ringer and Murrell have shown that nitrite of sodium possesses similar properties. It may be given in three grain doses.

During the fit *guard the tongue.* In the Paris Clinique d'Accouchements the tongue is put back, when protruded at the beginning of the fit, by pressing on its back with the edge of a folded napkin stretched between two hands and held between the jaws until the fit is over. A cork or a piece of India rubber held between the jaws at the molars answers very well.

Cold to the head or elsewhere should be avoided. We have seen it provoke a fit.

Excellent results have followed the subcutaneous injection of *morphia.* Barker and Hecker give clinical evidence of its value. Dr. Bowstead[2] relates two cases in which injection of 2♏ of Fleming's tincture of aconite, and ½ gr. of morphia, acted most successfully. Scanzoni used it. Belladonna acts well. In the form of atropia-injection it is most convenient.

Pilocarpine has recently been tried on the initiation of Hyernaux.[3] In our opinion, the results of the experiments are not encouraging.

Postural Treatment.—Graily Hewitt and Routh, believing that the disturbances of the abdominal and renal circulation, caused by pressure of the gravid uterus, exercised a powerful influence in provoking eclampsia, placed

[1] Brit. Med. Journ., 1882.
[2] Lancet, 1869.
[3] Du Chlorhydrate de Pilocarpine en obstétrique, 1879.

the patient in such a position as to diminish this pressure. Routh had seen marvellous benefit from the knee-elbow posture. It must often be difficult to adopt this posture; but the side or semi-prone posture may be tried.

A question of great moment, one that often calls for prompt solution is: *Shall the gestation be interrupted?* Can we venture to let the gestation go on? The disease depends upon gestation. Can the system bear the double strain of gestation and of the disease, working, as it must do, with organs which have proved unequal to the task? The question, as we have seen, is frequently solved by Nature. Labor comes on spontaneously. The system over-taxed throws off the burthen. Another example of many illustrating the maxim that abortion is often a conservative process. But Nature, whilst showing us the way, sometimes procrastinates too long. Does she present us with any indications to guide us as to the when and how to help her? If we carry the feeble policy of temporizing too far, the opportunity of rescuing the woman from imminent peril may slip away.

We would say (1) that in every case in which convulsions have set in, premature labor should be induced; (2) that where there is marked albuminuria with œdema, difficulty of breathing, a quickened pulse, with rising temperature; or amaurosis or other form of paralysis, and relief does not follow bleeding, purging, and sedatives, the operation should not be deferred; (3) when the patient has had albuminuria in previous gestations, or is known to have had Bright's disease and hypertrophy of the heart, no time should be lost before labor is induced. We must not suffer the gestation to go on when it imperils life, or permanent damage to the kidney or the eye.

The Good Effect of Labor.—The moment labor is started a call is made upon the nervous centres for nerve-force to be expended upon the uterus. This is its physiological destination; and if it can be kept steadily directed to this, its proper work, we may hope to obviate its diversion to convulsion or other morbid action. It is indeed a matter of observation that uterine action will often excite a convulsion. But upon the whole we believe it acts beneficially; and we shall be the less afraid of calling it into operation if we reflect, first, that labor must take place, and that it cannot be effected without uterine action; and, secondly, that we can greatly control the irritability by chloroform. The induction of labor is the most natural means of discharging the excess of nervous tension.

We have known a cough excite labor; but under other conditions of special influence, as of blood-poisoning, or of proclivity from hereditary dis-position, a cough might set up convulsion. We have seen an example of this in whooping-cough. This law of the propagation of excitation from one part of the spinal cord to another part in a state of peculiar susceptibility is admirably illustrated in a remarkable clinical experiment by Harvey. "It seems to me," says our Immortal Physiologist, "on deep investigation, that the throes of childbirth, just as sneezing, proceed from the motion and agitation of the whole body. I am acquainted with a young woman who during labor fell into so profound a state of coma that no remedies had power to rouse her, nor was she in fact able to swallow. Finding that injections and other remedies had been applied in vain, I dipped a feather in a powerful sternutatory, and passed it up the nostrils. Although the stupor was so profound that she could not sneeze, or be roused in any way, the effect was to excite convulsions throughout the body, beginning at the shoulders, and gradually descending to the lower extremities. As often as I employed the stimulus, the labor advanced, until at last a strong and healthy child was born without the consciousness of the mother." It is in the highest degree probable that in this instance there were albuminuria and urinæmia. But how well must Harvey have been acquainted with the ex

function when we see him thus turning it to practical account to accelerate the course of labor!

The intimate relation between the cerebral and spinal axes is further illustrated in the vivid sympathy which springs up between pregnant women. Thus, if a woman far advanced in pregnancy assist at the labor of another, she seems herself to catch every pain that seizes upon her suffering sister; and cases are known—we have seen one—in which labor in this way has been actually induced. The same thing, it is said, is observed in pregnant mares and cows, so that those who have charge of pregnant animals take care to separate from the rest any one which may be taken in labor.

The Mode of Inducing Labor.—In the first place observe the golden rule, "*festina lente*," avoid precipitance, that is, the "*accouchement forcé*." To deliver rapidly before the cervix is fairly dilated is to provoke violent convulsive reaction, to risk lacerating the uterus, and to reduce the child's chance to a minimum, thus sacrificing at one stroke the two objects of the operation. Proceed under anæsthesia; empty the bladder, puncture the membranes. This at once lessens uterine distention and irritation; then dilate the cervix gently by Barnes's bags; then proceed to accelerative measures as by forceps, turning, or craniotomy, according to the special indications.

Should there be œdema of the labia vulvæ, the preliminary precaution should be taken of draining the connective tissue either by a number of superficial digs with a lancet, or by Southey's drainage needles.

Conclusive arguments are based upon the following considerations, which apply to all the foregoing three conditions: (1) If the case be suffered to go on, even if the woman recover, every day adds to the strain upon the kidneys and the eye, and may lay the foundation of permanent disease; (2) it is not justifiable to let her run the risk of losing her life, or of drifting into grave disease, under the expectation of saving the child; (3) granted that the object of getting a live child should rule our judgment, the prospect is better of getting a live child in a future pregnancy than by trusting to the actual pregnancy already gravely threatened; (4) the fate of the child is linked with that of the mother, too commonly if the mother perishes the child perishes too; (5) we are doubly bound to seek our motive of action in the interest of the mother.

Admitting that some women have under our own observation and sanction gone the full period of gestation, and been delivered of living children apparently without damage, frankly speaking, we would not with enlarged experience, again encounter a responsibility so great.

If these arguments are fairly presented to the husband and friends they ought to prevail.

3. *The Restorative Treatment.*—When labor is over, the convulsions ceased, and the albumen disappearing, the proper treatment consists in rest, sedatives, light diet, of which milk should form a large element, avoiding stimulants. Iron is indicated, but its use should follow salines.

When able to endure it, warm baths should be used to promote the action of the skin.

Should the patient be much reduced by hemorrhages or otherwise, transfusion of saline solutions or defibrinated blood may turn the scale in favor of life. Dr. Lange[1] relates a case of recovery after thirty-two fits and severe exhaustion, after transfusion of seven ounces of defibrinated blood.

The urine should be carefully examined from time to time for some weeks after labor.

[1] Prager Vierteljahrsschr., 1868.

B. A Group of Paralytic Affections.

1. There may be paralysis of the special senses, as amaurosis, deafness, loss of taste, loss of smell, loss of touch. These have been described as sequelæ or attendants upon albuminuria and other forms of convulsion. Apart from this connection the paralyses are comparatively rare. We may call to mind aphasia and aphonia, also mentioned under "Albuminuria."

2. **Reflex Paralysis as Paraplegia.**—This, too, is sometimes associated with albuminuria. But it may have at least two other causes. The first is shock of labor, which seems to exhaust the spinal centre; the second is pressure of the uterus upon the sacral nerves. This may occur during pregnancy, but is more frequently caused during severe labor.

Lever has described two cases of paralysis of the limbs which ended in recovery after labor.

Paraplegia may be due to retroversion of the gravid uterus and pressure upon the sacral plexus. Retroversion may also cause reflex paraplegia (Brown-Séquard).

Apoplexy may occur at any period of gestation. Gestation testing the integrity of the organs, may find the cerebral bloodvessels unequal to the strain. We have seen it at the second, third, and subsequent months. It is perhaps most common at the time of labor. The complication is rare. In one case now under our observation, the subject æt. 28, a pluripara, was seen by Dr. Wilks, when seven or eight weeks pregnant; she had been seized suddenly with weakness of the right side, with some difficulty of speech; an hour later she became fainter, speechless, and paralyzed on the right side. Complete right hemiplegia and aphasia set in. She had slowly recovered partially from the hemiplegia and more completely from the aphasia when six months gone. No albumen was detected until during convalescence, when a trace appeared. The hemiplegia persisted, but delivery took place naturally at term.

Dr. Wilks communicates a second case, that of a primigravida, æt. 22, who was struck when three months pregnant. The attack began with severe neuralgia of the head, drowsiness and lethargy followed; stertor, left hemiplegia, lateral divergence of head and eyes, slight convulsions preceded death. "A clot of blood was found in the substance of the brain," and an antemortem clot in the left lateral sinus. This suggested thrombosis of vessels as the cause of the hemorrhage.

The paralysis, if unilateral, is likely to be the effect of cerebral apoplexy, associated or not with albuminuria. Apoplexy in gestation, independent of albuminuria and convulsions, we believe to be rare. In two cases seen by us the stroke occurred during the expulsive stage of labor, when the glottis was closed, and the tension upon the cerebral arteries was at its maximum. In one of those the woman was over forty, and it is not improbable that the cerebral arteries were in process of degeneration. Clotted blood was found. This subgroup is intimately linked with group A. Indeed, as is continually observed, the affections more prominently referred to one organ or fluid, overlap or dovetail with the primary or secondary affections of other organs.

Dr. Hughes Bennett, in an instructive lecture,[1] relates six cases of chronic hemiplegia. In two the disease began in pregnancy; in one, suddenly during labor; in two, soon after labor; in one, three weeks after an abortion. No albuminuria was noted when these cases came under Dr. Bennett a long time after the attack. He sums up as follows: These six cases of chronic

[1] Brit. Med. Journ., 1881.

hemiplegia are due to a destructive lesion in that portion of the brain supplied by the middle cerebral artery; the disease began suddenly during the puerperal state, which was the predisposing cause of it; the exciting cause was probably an embolus; this embolus was the result of acute endocarditis, or due to the hyperinotic state of the blood, or possibly to both of these conditions combined. It will be noted that four of these cases occurred after labor—that is, at a time when the disposition to thrombosis is greatest, a proposition which will be set forth more fully when describing the diseases of puerpery.

Cerebral thrombosis is, we believe, a rare affection during gestation. Embolism is essentially an affection of puerpery, and it will be more profitably studied in connection with the proper puerperal pathology.

Thrombosis of the cerebral sinuses, Wilks says, occurs mostly in anæmic women.

C. A Group of Mental Disorders (Including Puerperal Insanity).

Insanity in women, associated with childbearing, is best studied in harmony with the scheme of this work under the four epochs of gestation, delivery, puerpery, and lactation. The conditions of the blood and circulating organs, of the nervous system, and of the body generally, present features which differentiate these epochs, although they are physiologically linked together. On this ground it will be more instructive to take the subject throughout the four epochs continuously.

Relative Frequency of Insanity in the Different Epochs.—Esquirol noted 54 cases arising in puerpery, and 38 during lactation, out of 92 patients.

Marcé found in 79 patients, that 18 fell ill during gestation, 41 in puerpery, and 20 during lactation.

All statistics concur in showing that insanity does not declare itself so frequently during gestation as after labor.

The causes of puerperal insanity are predisposing and exciting, in this respect, as in others, falling under the common laws under which insanity is developed in other subjects.

Of all the causes, *heredity* occupies the first place. Esquirol has traced hereditary influence in 1 out of 2.8 cases; Marcé traced this influence in 24 out of 56 patients; and there cannot be a doubt that more exact information than it is often possible to obtain as to the consanguineous history would reveal a much larger proportion. It is a factor in most cases, no matter at what epoch the outbreak may happen.

Anæmia, produced by gestation, increased by labor and puerpery, is an important element in etiology. It may be partly predisposing, partly exciting. Certainly in most of the cases of insanity breaking out after labor we have found this condition; in some the anæmic souffle was marked. The late Dr. F. W. Mackenzie, whose researches on phlegmasia dolens we shall have occasion to cite, insisted much upon this. The influence of this condition may account for the comparative frequency of insanity in multiparæ whose constitutions have been impaired by childbearing and the development of debilitating diseases.

Linked with anæmia are certain states of *toxæmiæ*, more especially those depending upon *albuminuria* and *cholæmia*. The powerful influence of these states is exhibited in the fact that, arising, as they are especially liable to do, in primigravidæ, they are in a notable proportion of instances the precursors of insanity.

Lactation is a strong predisposing, if not also an exciting, cause, and related

to this condition is the fact supported by fair evidence, that suckling boys is more frequently followed by insanity than suckling girls. The first tax the mother's strength more severely.

Savage says:[1] "We must be prepared to recognize in hysteria, epilepsy, chorea, and perhaps rheumatism, diseases that are related more or less closely to insanity. If one parent be insane and the other phthisical, the offspring run a greater danger than if only one parent were tainted. Several cases have come under my observation, in which all those of the family who have not died of phthisis have had mental troubles."

The exciting causes are sometimes more apparent than real. There is no such frequent relation between *severe labor* and insanity as to suggest dystocia as a cause. *Hemorrhage* certainly is an efficient factor.

The use of *chloroform* in labor has been accused as an active cause. In the early days of anæsthetic midwifery, this reproach was hotly urged. It might, however, be supposed that the obliteration of pain and fear, two powerful agents in disturbing the equilibrium of the nervous system, would diminish the liability to insanity. Are the attendant evil influences of chloroform to weigh against immunity from pain and fear? Is it a fact that insanity in undue proportion follows the use of chloroform? To the first question it must be admitted that chloroform greatly disposes to hemorrhage, a powerful factor in the development of insanity. The second question is not so easy to answer with precision. But it is certain that chloroform confers no immunity from insanity. Probably no obstetric practitioner of much experience has failed to see cases of insanity breaking out after the use of chloroform. With certain reservations it may be affirmed as a physiological fact, however harsh the opinion may appear to some, that the pain of labor fulfils a useful function in regulating the nervous energy, in directing it to its proper destination. One of the reservations is the extreme sensitiveness of many women lapped in luxury, upon whom pain has a crushing effect, outweighing its physiological uses. It is also to be remarked that chloroform is most frequently given to women in whom the nervous system is most highly developed, and who are the more prone to fail under the trial of gestation.

The influence of *moral emotion or shock* has been too often observed to be doubtful.

The appearance of the *first menstruation after labor* has often been the signal of an attack of insanity. Baillarger pointed this out to Robert Barnes when studying at the Salpêtrière. He has verified this in practice, and, further, that succeeding menstruations have been attended by exacerbations of the malady.

In many cases more than one of the preceding causes are in action.

Marcé's idea was that there exists a sympathy between the uterus and the brain. This is the old idea. Certainly we have seen the clearest evidence of retroflexion, hyperplasia, and congestion of the uterus associated with insanity; and we have the conviction that by curing these complications we have cured the insanity. Graily Hewitt bears similar testimony.

Boyer relates a case of a lady who during her first pregnancy was attacked by insanity. Ten years later, the mental alienation having returned, it was concluded that she was pregnant. Boyer removed a polypus from the uterus, and she quickly recovered.

THE INSANITY OF GESTATION.—At the onset of gestation many women are overtaken by various nervous disturbances. The new situation brings a strange bodily and mental revolution. We have known women of the

[1] Guy's Hosp. Reports, 1875.

strongest character, not given to "fancies," not introspective, unwilling to yield to subjective impressions, or to excite sympathy, to be affected by hallucinations of sight and hearing, driving them to get out of bed, and flee from subjective perceptions, even to the point of running into danger.

The senses not only deceive them, but often fail them or become impaired. Thus the sight and hearing are at times enfeebled; temporary amaurosis occurs; the taste is often completely perverted, things heretofore eaten with relish are now objects of loathing, and things before disliked are now those which are sought. The "longings" of pregnant women have in all ages been familiar to mankind. Women may, indeed, sometimes turn them to account in order to get what they want. But it is nevertheless true that, in many instances, these "longings" are the expression of an irresistible bodily and mental disturbance.

Savage observes[1] that he has seen cases in which "unnatural longings in the mother have reappeared as melancholia and mania in the children." This affords strong presumption of the alliance of these longings, when passing ordinary bounds, with insanity.

Dipsomania and kleptomania are forms that occur.

One remarkable feature in the mental state of women during gestation is the pursuing dread that childbearing will be fatal. This idea seizes upon most women, pregnant for the first time, with more or less force; in some it dominates and depresses, assumes the character of melancholy, and may culminate in insanity. Indeed, the most common form of mental aberration in pregnant women is the melancholic. Associated with the mental disorder are certain bodily disorders: the digestion is disturbed, the liver and kidneys act imperfectly. We have several times seen jaundice preceding or complicating insanity.

In many women these mental aberrations subside as the gestation advances.

In some melancholic cases, suicidal tendency is marked.

Savage remarked that the suspicion of poison in the food was common. Most of the cases were suicidal. Hallucinations are common. Mania is also a form observed in gestation.

Does gestation exert a favorable influence upon insanity? The affirmative has been contended for by some authorities. Esquirol said the instances of insanity being cured or modified favorably are rare. Dubois and Désormeaux[2] state the case in these terms: "Mania, and especially dementia, often shows a favorable experience from pregnancy; but we can hardly hope for a durable amelioration or a complete cure, in these cases and in other chronic diseases, except when they depend upon disordered menstruation or certain diseases of the uterus." Outside these conditions they believe that pregnancy is hurtful rather than useful, not by itself, but by the debility which follows delivery.

In our own experience we have seen the truth of these opinions strikingly confirmed.

As to the *treatment*. Separation from friends is generally desirable. Remedies that reduce nervous and vascular tension are especially indicated. Savage speaks emphatically against the induction of labor. He says it will almost certainly only convert a case of insanity of pregnancy into a case of puerperal insanity.

Effect upon the Child in Utero.—Marcé, basing upon a small number of cases, shows that the children of insane gravidæ are more likely to

[1] Guy's Hosp. Reports, 1875.
[2] Dictionnaire de Médecine, art. "Grossesse."

be stillborn when the insanity declared itself during the gestation, than when the women were insane at the time of conception. The explanation seems to be that acute disease attacking a gravid woman causes more disturbance; and it is also probable that, in some cases, albuminuria is associated with the insanity.

What is the influence of labor upon insanity? The process rarely effuers much disturbance. A point which has been often observed is the remarkable unconsciousness of pain; in some cases, the woman has not been conscious of the delivery; and in not a few she has refused to believe that the child of which she had been delivered was hers. These facts point to the necessity of carefully watching an insane gravida, lest she fall into danger unperceived, and the child perish.

The Temporary Mental Aberration during Labor.—This form is generally recognized. It may occur in women who are not known to be the subjects of predisposition to insanity. It is a transient delirium. It is most commonly observed at that stage of labor when the head is stretching the cervix uteri or the vulva; that is, when the pain is most excruciating, and when the whole system is under the empire of the reflex nervous system. At this stage it is not surprising that a frenzied desire to be released at any cost from her agony should overpower all self-control. Hence a woman may attempt violence upon herself or upon her child at the moment the head is born, or soon after complete delivery. Such cases, it is true, are more frequent in single women, to whom childbirth brings not only acute physical suffering, but the most poignant mental distress, and the prospect of misery. Delivery under chloroform or ether will entirely obviate this form of transitory mania.

In the great majority of instances this form of aberration passes away in a few minutes or hours. But in women predisposed to insanity, this acute mania of labor may be the starting-point of persisting insanity. A similar argument applies when there is albuminuria.

Simpson, in his first enthusiasm for chloroform, claimed it as a prophylactic against puerperal insanity. This has been falsified by experience. We ourselves have known cases of mania break out after the use of chloroform in labor. It is doubtful whether it possesses any virtue in lessening the risk of insanity, unless it be, and this is important, in mitigating albuminuric eclampsia, a disorder which sometimes is the forerunner of insanity.

The Insanity of the Recently Delivered Woman.—This is the most frequent of all the varieties of insanity connected with childbearing. The forms observed are mania, melancholy, hallucinations, monomania, and a particular form of mental debility observed after severe hemorrhages, which is not difficult to cure by tonic treatment.

Mania is the most frequent form. This may or may not be ushered in with fever. We have found no elevation of temperature or pulse, but the skin is often dry. There is a dry tongue, thirst, insomnia, excitation, violence in action and in speech, sometimes erotic ideas, more often aversion from husband and child. Simpson made in one case the remarkable observation that albuminuria followed on three successive attacks, and disappeared on recovery. But the association is by no means constant.

The outburst of mania in a large proportion of cases occurs at two distinct epochs: in one class within the first eight days, in the other not before the fifth or sixth week. This may be explained by the action of the shock of labor and the establishment of milk secretion in the first class, and by the first menstruation in the second class. About two days after delivery some women become excited, sleepless, incoherent; the face is flushed, pulse rather full, and there is slight rise of temperature.

THE PROGNOSIS AND DURATION OF THE DISEASE.—The prognosis bears upon two points: 1. The danger to life. 2. The prospect of cure of the disease. A certain proportion of cases terminate fatally within a few days or weeks. Of those that survive by far the greater number, probably three-fourths, recover their reason. Gooch used to say that the question was not "Will they recover?" but "When will they recover?" Subsequent observation, however, compels a modification of this assumption. The greater number recover within twelve months, many in a much shorter time. Of those in whom the disease lasts beyond a year, a considerable proportion are incurable. The cure is slower in melancholia than in mania. Savage says in most cases of mania the cure is made in three months, in melancholia it takes six months.

The immediate cause of death is usually acute delirium (Marcé). Other cases terminate by tubercle in the lung, pneumonia, pyæmia, or Bright's disease.

It may be said generally that puerperal mania threatens life, and melancholia threatens reason.

The Insanity of Puerpery Proper.—The transition from the violent agitation of labor to puerpery is commonly marked by calm. But under the new condition, the disposition to mental aberration is revived. What are the causes that call this disposition into activity? The favorite doctrine of old —expression of the humoral theory—was that the insanity was caused by the suppression of the lochia and of the secretion of milk. This theory in one of its modifications rested upon the assumption that there was metastasis of these fluids. In popular belief these theories still hold a place. "Those things," or "the milk flew to her head," is an expression we sometimes hear. In its literal sense of course this theory has no place in science, but it contains an element of truth. Broussais[1] stated his opinion as follows: "The insanity so common after labor does not arise under the influence of one organ alone; all are in a state of surexcitation; at this epoch so remarkable, congestion is imminent for all the organs, and if the necessary evacuations are interrupted, a slight cause may fix itself upon the brain, as upon any other visceral apparatus, and this determining cause is often of a moral kind." Thus this eminent author, accepting the prevalent humoral theory, sought in the complex conditions of gestation the solution of the problem, assigning, however, to congestion an active part.

As to the suspension of the lochia, it has been observed that sometimes the flow is prematurely suppressed, that sometimes it continues uninterrupted, and that not seldom the insanity breaks out after the flow has run its normal course. Much the same statement may be made as to the milk. But in the case of this secretion, there is greater difficulty in arriving at conclusions. When a woman becomes maniacal, she is rarely allowed to suckle, and so the milk dries up. Whether insanity dries up the milk or no, it is not easy to decide. We ourselves have seen a case in which insanity broke out a few days after labor whilst suckling; the child was taken from the mother, who was sent to an asylum. There she stayed two months, came out well, and resumed the care of her infant, when the milk came back abundantly.

Insanity in Suckling Women.—Insanity begun during gestation or puerpery may be continued into the period of lactation. But it may originate after puerpery. The proportion of cases commencing at this period are not nearly so frequent as those of puerperal origin. This may be partly explained by the consideration that women predisposed to insanity will succumb under the trial of gestation, labor, and puerpery, and that

[1] De l'irritation et de la folie, 1839.

emerging safe from that ordeal, they will have proved at least comparative soundness.

Generally speaking, the causes of insanity during lactation are the same as those which act during gestation and puerpery. But there are special conditions which it is of practical moment to note.

All the cases of insanity which break out in lactation may be arranged in two classes: 1. Those which appear during the first six or seven weeks after labor. These are intermediate between the proper puerperal and the lactation cases. 2. Those cases which occur much later, that is, after eight, ten, or even twenty months of nursing, or within a few days after weaning. It is rare to observe insanity originating during the intermediate period.

The most obvious factor in the production of insanity during prolonged lactation is anæmia and debility. In some cases we have known a complication with a new pregnancy, and in some the reëstablishment of menstruation. These conditions importing fresh elements of nervous and vascular disturbance, seem to determine the outbreak. In many poor women, the struggle to support the suckling is rendered harder by lack of food and bad hygienic surroundings. If, in spite of anæmia, women persist in nursing, and sleeplessness supervene, disturbances of innervation or of nutrition soon arise, and render the system susceptible to morbific influences. Emaciation, pallor of the mucous membranes, languor of all the functions, are noted; and a special risk arises, pointed out by Nasse, that is, of softening of the cornea, just as happened to the dogs subjected to long starvation by Magendie. This condition ceased on weaning, and returned on suckling. Mr. Power tells us of a similar process, but thinks the starting point is a scratch upon the cornea.

In other patients, nervous symptoms predominate. Neuralgia, partial paralysis, contractions of the muscles, are met with, sometimes of tetanoid character. Acute dementia sometimes sets in, and catalepsy is not infrequent.

The Effect of Weaning.—In some cases timely weaning may arrest the insanity, or apparently obviate its outbreak. But in some cases insanity breaks out on or soon after, the weaning. This may be explained, first, by the fact that weaning was enforced because the nervous system was evidently giving way: in these cases clearly the weaning is not the cause. Secondly, the milk has dried up under a sudden physical or emotional shock; here the insanity is due to the shock, which at the same time arrested the secretion of milk. Thirdly, in some cases insanity may break out some days after weaning, under conditions distinct from the first two described. Is there a special danger from the revulsion attending the sudden arrest of the milk secretion? Does this secretion act as an emunctory, and being checked, some deleterious element is left to work as an irritant to the nervous system? These questions are not easy to answer.

In a large proportion of cases it has been observed that insanity breaking out during lactation has not arrested the milk secretion.

Mania and melancholy occur in about equal proportions during lactation.

The Prognosis is generally favorable. The duration of the illness may extend to some months, but is not seldom cured in a few days or weeks.

The Treatment.—The first indication is clearly to stop the cause of exhaustion, to wean, then to regulate the secretions, to feed well, and to place the patient in the best conditions for quiet and health. Opiates, bromides, quinine, iron, will render signal service. Shower-baths are often useful.

Shall a woman who has recovered from insanity return to her husband?

If the insanity has been associated with uterine disease which has been cured, our experience is favorable to the renewal of conjugal relations. We have known subsequent pregnancies proceed happily.

On the question of marriage of women who have been insane, our experience, which upon this point is not inconsiderable, agrees with that of Savage, who says: "It is satisfactory to know that we do see patients who have recovered from insanity marry and bear children with impunity; and I am inclined to think that we shall some day be able to point out certain varieties of mental disease that are scarcely more liable to return than are broken bones."[1]

The Responsibility of Pregnant Women and of Women in Labor and Puerpery.—This is a medico-legal question, the discussion of which would lead us beyond the proper limits of this work. We can only state the chief points.

1. In the case of women who have been undoubtedly insane before the actual pregnancy, the presumption, *primâ facie*, is that any extravagant or criminal act she may commit, especially if inconsistent with her natural character, is done under the influence of insanity.

2. Since in the early stage of pregnancy it is not uncommon for women to be subject to passing hallucinations which may influence their actions, it is quite probable that in this state they may do things for which they ought not to be held responsible. The temporary hallucinations, or illusions, or delirium of epileptics present an analogous condition.

3. The temporary delirium or aberration at the moment of delivery, when a woman is "beside herself" with pain and emotions—under the control, in short, of the reflex nervous system—has always been held to be a condition during which she may commit acts for which it is difficult to prove her responsibility.

The English courts but rarely find any girl guilty of murder for infanticide soon after labor. The madness may be at most a temporary furor, a madness that exhausts itself in the impulsive commission of the crime.

We may fitly conclude this section on convulsive diseases with a few general observations.

To show how nearly an expulsive labor pain is allied to convulsion, observe the course of a pain towards the end of labor. A premonitory shudder (the forerunner of the storm), often a rigor, often vomiting, usher in the pain, just as we frequently observe before the outbreak of a fit of epilepsy. Women have told us that at this moment they felt sure they were on the verge of convulsion.

We have known several instances of an epileptic fit being repeatedly induced by the sexual act. Tyler Smith told us of one. Voisin mentions one. La Motte knew a woman who, not pregnant, always vomited *solâ actione coitûs*.

General Considerations.

We cannot fail to be struck with the common features of resemblance or of relationship between the different forms of convulsive disease which occur in pregnancy. In this comparison we ought to include the relationship of syncope, vertigo, migraine, apoplexy, paralysis, delirium, insanity. They often form links of one chain. Syncope and vertigo should be studied in their relations to epilepsy; apoplexy in its occasional relations to uræmic eclampsia; paralysis in its relations to apoplexy and epilepsy; and insanity in its relations to epilepsy, eclampsia, and chorea. All the convulsive diseases may culminate in mania or dementia.

What is it, then, that determines epilepsy in one case, vomiting in a second, chorea in a third, tetanus in a fourth, eclampsia in a fifth? We

[1] Some interesting illustrations of puerperal insanity have been published by Dr. A. Campbell Clark. Lancet, 1883.

must invoke a peculiar antecedent condition of the nervous centres, probably unknown or unsuspected until it declares itself under the magical ordeal of gestation. This is illustrated by the history of chorea, which, we have shown, rarely, if ever, occurs *ab initio* in gestation, the subjects having had it in childhood; in epilepsy, in the subjects of which there can generally be traced hereditary proclivity or previous attacks. But the postulate of an antecedent condition is indisputably settled by the case of ague. We cannot conceive the possibility of ague being evolved out of the proper conditions of pregnancy; and we know that other conditions will act in reproducing ague.

Pathological Exaggerations of Physiological Affections of the Heart and other Organs of Circulation.

In tracing the normal history of gestation, we have sketched the features which gestation impresses upon the blood, heart, and other organs of circulation. To that sketch we refer back, as the basis of what remains to be said concerning the phenomena resulting from pathological excess.

The blood may present an unusual degree of anæmia. There may be exaggerated leucocytosis, and even the condition called acute idiopathic or pernicious anæmia.

These are conditions favorable to serous effusions and œdema, and even to hemorrhage.

Virchow combats the general opinion that chlorosis is due simply to alteration in the blood, urging that structural changes in the vascular apparatus are concerned;[1] and defends the proposition that the origin of inflammatory affections of the heart is determined by mechanical causes. He agrees with Raciborski, that chlorosis almost always leaves traces for the rest of life.

He frequently recognizes in autopsies *recent* and *recurrent* endocarditis. He says they are easily misinterpreted clinically and set down as ordinary puerperal fever. These are commonly complicated with obvious diseases of the uterus and adnexa. So endocarditis is only a complication of the puerperal state. He affirms that there is a special predisposition to puerperal endocarditis in a peculiar defective formation of the vascular system. This is brought into play by gestation and puerpery. The altered nutritive processes of gestation, and still more of puerpery, increase this predisposition, and lead to the greatest development in the defective organs.

Embolic processes affect chiefly three organs: kidneys, spleen, retina; and the choroid and the joints.

The Heart Affections.—Under the influence of undue anæmia, and probably other factors, the chief of which are nervous tension and irritability, the hypertrophy of the heart may exceed the usual limits. Ollivier says,[2] if the irritation be carried beyond a certain point, inflammation of the myocardium may ensue, leading to fatty degeneration. He, however, cites Spiegelberg's case of sudden death three days after labor from *rupture of the left ventricle*, in consequence of acute myocarditis; there was considerable fatty degeneration. The heart, generally, was flaccid and brittle; the valves were sound.[3]

[1] Virchow: On Chlorosis and the Related Anomalies of the Vascular Apparatus, especially with Endocarditis Puerperalis. 1872.

[2] Archives générales de Médecine, 1873.

[3] Robert Barnes saw at the Hôpital des Cliniques, at Paris, under Dubois, a singular case of sudden death during defecation from the rupture of a hydatid cyst in the wall of the aorta. It burst into the pericardium. The subject was an otherwise healthy primigravida expecting her labor.

Ollivier further cites Danyau and Mordret as giving cases of myocarditis.

Fatty degeneration of the muscular fibres of the heart must not be taken as absolute proof of antecedent inflammation. In several instances of women dying suddenly during and after labor, we have observed fatty degeneration. This has been in women worn down by repeated pregnancies, and ill-nourished. It must be remembered that the normal excess of muscular tissue developed during gestation has to be removed by a process similar to that by which the involution of the uterus is effected. At any rate, this fatty change observed in subjects dying several days after labor must be regarded in relation to this process.

Endocarditis is sufficiently attested. It may, says De Lotz, be primitively chronic, or consequent upon acute or subacute endocarditis. Dr. Millard, cited by Ollivier, describes a case of simple acute endocarditis coming on towards the end of gestation, characterized by a rough systolic sound at the level of the apex, frequent pulse, at times irregular, and some dyspnœa. The symptoms subsided gradually, and in ten weeks had nearly disappeared. The very acute form was described by Simpson.

It is highly probable that in some cases there was albuminuria. The reception of noxious matter into the blood may determine the disease.

One cause of endocarditis may be puerperal rheumatism.[1]

As we have had occasion to repeat, *thrombosis and embolism* are especially diseases of low vascular tension attending the involution-process of childbed. All the forms are rare during gestation. The train may indeed be laid during gestation, but the explosion is deferred until after labor, when the waste stuff of disintegration of tissues is thrown into the circulation. We have, however, seen a few examples of so-called phlegmasia dolens during gestation; one especially marked case in a lady in the sixth month of gestation presenting all the characters of "phlegmasia dolens."

Embolism, when it occurs, is more likely to be the result of endocarditis started before the pregnancy; fibrin deposited on valves already affected may break up, give rise to emboli, and these may be carried to the lungs or to the brain. The left heart is the more frequent seat of this disease in gestation, the right in childbed. The subject is simply recorded here for classification. It will be fully described under the "Diseases of Childbed, or Puerpery." As has been shown at page 304, it may lead to apoplexy and paralysis.

Pericarditis.—Ollivier has not seen primitive pericarditis during pregnancy, but there seems to be no improbability of its occurring.

Dr. Macdonald says:[2] "The evils likely to arise from pregnancy in connection with cardiac lesions seem to be referable to two classes:

"1. Destruction of that equilibrium of the circulation in heart diseases which has been established by compensatory arrangements. This result seems intimately associated with the high vascular tension and coincident hypertrophy of the left heart, present during the later months of pregnancy.

"2. Introduction of fresh inflammatory lesions upon the valves and endocardium of a heart already weakened by disease. These changes may either assume the type of ordinary plastic endocarditis or of ulcerative endocarditis."

Ollivier affirms that the discovery of the modifications which the endocardium may undergo in gestation furnishes in some cases an explanation of the so-called *puerperal hemiplegia*. As a consequence of the progressive course of the valvular lesion, and of the distress in the circulation caused by the

[1] See Simpson, 1856.

[2] The Bearings of Chronic Diseases of the Heart, Pregnancy, Parturition, and Childbed, 1878.

gravid womb, fibrinous deposits, vegetations, may be detached, forming embola, carried to the arterioles at the base of the brain. He relates a case in which there was no rheumatism, chorea, fever, or syphilis.

Robert Barnes has seen several cases of hypertrophy of the heart, apparently starting from gestation, end fatally soon after labor. They occurred in women approaching forty. The morbid process may be stated thus: The greater development of the uterus, and the necessity of maintaining the fœtus, demand greater cardiac force; hence hypertrophy, which has to be reduced by involution. In an enfeebled system, involution is impeded; fatty degeneration remains, and the patient dies of heart disease. This is more especially likely to happen if the first pregnancy occur at an advanced period of life, when the system is unequal to those sudden impulses of evolution and involution, those active processes of nutrition and atrophy, which are inseparable from gestation.

Simple Goitre.—One of the most interesting consequences of hypertrophy of the heart is the hypertrophy of the *thyroid gland*, or *goitre*. This probably differs in kind, as it certainly does in origin, from the goître of mountainous districts. Laycock found goître much more common in women than in men —that is, there were but 26 men out of 551 cases.

J. L. Petit (1740) recognized the influences of menstruation, pregnancy and labor, and puerpery in causing goître. In the case of his wife, Petit observed that the affection may persist and increase in succeeding pregnancies, and that the gland may inflame and suppurate.

Dr. E. W. Jenks[1] has written an excellent history of this subject, to which we refer for fuller information than can be given here.

Of late years the relation between pregnancy and goître has been generally recognized. We ourselves have seen, and have under actual observation, several striking examples. Guillot (1850) wrote a valuable memoir, and Ollivier (1873) described it carefully. He says it usually appears about the third or fourth month of gestation. He describes one form as subacute and temporary; this never causes distress on breathing, is not subject to pulsation, and is therein distinguished from the vascular or exophthalmic goître. It appears after labor. In a second form, the goître may develop rapidly, and cause serious distress. Tarnier relates a case in which symptoms so threatening came on that labor had to be induced. Tarnier admits that the enlargement diminishes somewhat after delivery, but that it rarely disappears entirely. This is completely verified by our own experience. The hypertrophy once started, the consequences are hardly ever completely obliterated.

Goître may develop *slowly during gestation*. In this case the hypertrophy is explained by the high vascular tension maintaining engorgement of the vessels of the gland. It may be developed *rapidly under the effort of labor*. Independently of gestation, violent muscular exertion has been known to cause goître. Dr. Luton[2] gives examples of this influence. Under the straining of labor, no doubt the pressure upon the thyroid vessels is greatly increased. May not this reception of a large volume of blood, serving as a diverticulum, exert a conservative influence by sparing the brain?

The swelling, tension, and distress of the enlarged thyroid undergo marked exacerbation at every menstruation. In one case, under our observation for many months, this periodical swelling was very marked. The tumor almost disappeared when dysmenorrhœa depending upon atresia of the os

[1] "The Relations of Goître to Pregnancy and Derangements of the Generative Organs of Women." Amer. Journ. of Obstet., 1881.

[2] Nouveau Dictionnaire de Méd. et de Chir.

externum uteri was cured by enlarging the os by incision, aided by appropriate general treatment.

In connection with this disease, Graves enunciates a theory of *globus hystericus* which deserves attention. He connects this sensation with a temporary enlargement of the thyroid attending palpitation. This sensation, he says, only continues whilst the paroxysm of palpitation lasts. The lump in the throat which the subjects complain of is often referred exactly to the seat of the thyroid.

Macdonald advises that *marriage* be forbidden to persons having chronic heart disease, especially stenosis of the mitral valve, or serious aortic incompetency. Dyspnœa, hæmoptysis, palpitation on exertion, are contra-indications.

Lactation and overexertion should be forbidden to subjects of such disease.

Exophthalmic Goitre.—Sometimes called Graves's disease, and Basedow's disease. The title of Basedow to give the disease a name falls before the antecedent claim of Graves. Parry before 1825 described the connection between enlargement of the heart and enlargement of the thyroid. Graves[1] stated the following conclusions: That under certain circumstances the action of the heart may become permanently excited, as shown by its rapidity, irregularity of action, and increased force; and that this state is attended with three remarkable epiphenomena: first, turgescence of the thyroid gland; secondly, increased action of the arteries of the neck; and, thirdly, the enlargement of the eyeballs; and that it is most commonly observed in females, associated with hysteria, neuralgia, or uterine disturbance. The case could not be more truly or concisely stated. The increased action of the heart, postulated, obtains in a marked manner in gestation, under which state a large proportion of cases arise.

Attendant upon the hypertrophy of the thyroid gland, it is not uncommon to observe the development of exophthalmos. The two conditions undoubtedly own a common origin. Both start from the high vascular tension of gestation exaggerated by undue hypertrophy or irritability of the heart. The first symptoms are palpitation, a rapid pulse, often 140, then nervous debility. These are followed by enlargement and pulsation of the thyroid gland, violent beating of the carotids, and, lastly, projection of the eyeballs. This last condition is sometimes painfully striking, suggesting a likeness to the pedunculated eyes of some crustacea.

The thyroid gives sometimes a vibratory thrill to the touch, and a musical sound may be heard by the stethoscope.

The theories of etiology may be classed as nervous and vascular. Both systems are undoubtedly concerned, and it is difficult to assign priority or predominance to one or the other. The immediate cause is assuredly in the vascular system which brings the blood, the *sine quâ non* of hypertrophy, to the gland. But there may be in most cases a precedent condition of the nervous system, which impels the heart to drive the blood with undue force. If the nervous system then acts first, it acts through the medium of the vascular system; thus the nerves may initiate and keep up a trophic action. The essential part played by the vascular system is demonstrated by the important observation of Warburton Begbie,[2] who says that albuminuria is almost always concomitant with exophthalmic goître, and that it is met with not only in the advanced period of the disease, when the heart is disturbed in its function, but almost at the very beginning of the attack. George Johnson has observed the same relation. Alexander Robertson, Morell Mackenzie,

[1] Diseases of the Heart, 1854. [2] Edinb. Med. Journ., 1870.

and Meynert have each related a case in which insanity ensued upon exophthalmic goître.

The structure of the goître is sometimes that of simple hypertrophy of the natural tissues; sometimes cysts are formed in the gland. These may be the result of absorption of apoplectic effusions. In another form, described as *vascular*, the arteries are greatly dilated and sinuous; the veins are swollen. Cornil says the vessels exhibit sac-like dilatations.

A swelling doubtfully classed here is the *emphysematous goître* of Larrey, the *air or pneumo-guttural goître*. This is formed at the front of the neck, especially at the sides of the larynx. It sometimes attains a considerable size. Heidenreich cites several cases. The swelling is not strictly in the thyroid. We have ourselves seen some remarkable examples. They occurred under the violent throes of the expulsive stage of labor, one in particular under the influence of ergot.

THE TREATMENT.—The disease once started is likely to go on if the causes persist. It must therefore be an anxious question whether a woman in whom the disease has made progress during gestation should be allowed to nurse her child. During the growth the most rational prospect of checking it is based upon moderating the action of the heart and improving the quality of the blood. To this end, digitalis, bromides, and iron are indicated. We can attest their value. In the chronic state, iodine and iron are useful. If the tumor is large and firm, injections of ergotine or iodine and galvanism have given good results. In the cystic form, aspiration or hair-setons to drain the cysts and excite adhesive inflammation may be tried. Morell Mackenzie has cured many cases by injecting ferric chloride. When dyspnœa is distressing, and especially if asphyxia threaten, Duncan Gibb proposed to liberate the pressure on the larynx by dividing the isthmus. Recently Mr. Sydney Jones[1] advocated excision of the isthmus, and described a successful case. The operation was followed by atrophy of the gland substances. This proceeding will certainly supersede the dangerous one of total extirpation of the gland.

Phlebectasis, Varicose Veins, Hemorrhoids.—This subject has been systematically described by Briquet[2] and by Budin.[3] Varices are noted in, 1, the lower extremities, 2, the external and internal genital organs, 3, the anus and rectum, 4, the urethra and bladder, 5, on the trunk.

1. Phlebectasis of the *lower limbs* may affect the *superficial veins* and the *deep veins*. The veins may be simply enlarged, or dilated with thickening, or dilated unequally; and there may be the changes in related veins called venosity. In the simple dilatation and the dilatation with thickening, the calibre is increased, but the form of the vein remains cylindrical. In the third form there are lengthening and flexuosity, the vein may acquire two or three times its natural length, and its coats alter; the middle membrane is thinned in parts, in others thickened. This produces projections into the cavity of the vein. Varicose bulgings are formed resembling aneurismal sacs. These dilatations are formed above or below the valvules. Sometimes the valvules are folded back, even torn. It is obvious that the proper function of veins so affected is impaired. The circulation is impeded. Thrombosis is favored. Cornil has shown that new connective tissue is found in the veins, and venous sinuses result.

In the case of large varices, the surrounding tissues are thickened, lardaceous, and in places the appearance is as if the thinned compressible walls are tunnelled out of the hardened tissues.

[1] Trans. of Clinical Soc., 1883.
[2] Mémoire sur la phlébectasie, Arch. de Méd., 1825.
[3] Des varices chez la femme enceinte, Thèse de Concours, 1880.

The chief seats of the superficial varices, are the level of the internal saphena; sometimes the course of the external saphena; the internal aspect of the thigh. Œdema is not a constant attendant.

Phlebectasis may affect the deep veins of the leg, the *venæ comites*. A symptom of this, says Verneuil, is severe pain in the sole of the foot. The sign should never be neglected. It comes on in the upright posture, and subsides on lying down. The pain may be explained by the pressure upon the nerves. Verneuil also calls attention to a sign common in varicose subjects. The varicose limbs are the seat of permanent moisture and free epidermic desquamation.

Causes.—Varices may develop during the first pregnancy, and even during the early months; but they are more frequent in pluriparæ, and often more developed in the later months. They have been attributed to pressure of the gravid uterus, a condition so often invoked to explain many diverse phenomena of gestation. Since varices may arise very early in gestation, and even under the influence of menstruation, pressure cannot be an essential cause. They, moreover, are rare in the case of even large ovarian cysts, as Kiwisch pointed out. At least three factors concur: 1, increased volume of circulating blood; 2, increased arterial tension; 3, increased nervous tension. Under the increased pressure the weaker vessels give way, especially those in which the centripetal current is liable to retardation, as is the case with the veins of the inferior extremity, under the influence of gravitation. Kiwisch attributes considerable influence to the "serous blood-crasis" of gestation.

Ulcerations occur but rarely in pregnant women. Erysipelas occurs now and then. Ulceration may eat through the vein and *permit hemorrhage* difficult to repress, and even fatal. Murat relates a case. Robert Barnes attests another. Bryant records a case in which a varix burst subcutaneously, forming a large swelling inside the thigh. It was absorbed.

Thrombosis and phlebitis do not frequently occur during gestation. But thromboses do sometimes form in the course of the varicose vein. Waldeyer, Cornil and Ranvier, against the statement of Virchow, contend that the clot does not become organized, but that the changes observed are the result of modifications in the wall of the vein. Sometimes inflammation and suppuration take place in the seat of the thrombosis. Blot has described a spontaneous radical cure as arising in two cases from this process.

Treatment.—Women affected with large or tortuous varices cannot without risk undergo severe exertion. Equable compression by well-made and well-adjusted stockings or rollers is useful in supporting the yielding coats of the vessels; and from time to time relief must be sought in the horizontal posture. It is proper to note that some cases have been recorded in which compression of the veins seemed to provoke abortion and other troubles. Not ignoring these cases, we cannot think them so weighty as to call for the neglect of a treatment undoubtedly of great service in many cases.

Martin and Spiegelberg advised to attempt the radical cure by the subcutaneous injection of ergot near the varices. The method is painful, not without danger, and its efficacy is doubtful, since it is necessary to combine with it rest. In the event of varices assuming great size and threatening to burst, it may be wise to ligate them.

2. Varices of the Vulva and Vagina.—These form especially in the labia majora; sometimes forming large convoluted brain-like masses projecting visibly, sometimes on one side, sometimes on both. Varices not uncommonly form in the vagina as well, presenting deep violet convolutions. In one case reported by Robert Barnes a mass projected beyond the

vulva, which the woman took to be the child's foot. She was delivered without accident. The veins subsided.

Then varices may burst and give rise to serious hemorrhage. Simpson (N. Y.) reports a fatal example. Tarnier relates one the result of a blow on the vulva. Simpson relates a case which nearly proved fatal from coitus. Hemorrhage from rupture of varices in the vagina has occurred during labor.

Hemorrhage may also take place from the clitoris under injury. If the rupture take place beneath the mucous membrane, which itself is not wounded, blood collects in the connective tissues, forming a *thrombus*. This condition will be more particularly described in tracing the history of "hemorrhage."

In the event of hemorrhage from bursting of vaginal varices during pregnancy, plugging offers the best results.

Varices also form in the *cervix uteri;* these will be described under "Hemorrhage."

Varices in the Broad Ligaments.—The utero-ovarian plexus sometimes undergoes great tortuosity under the influence of menstruation simply; and the over-distended vessels may even burst; constituting one form of retro-uterine hæmatocele. This varicosity is still more frequent and considerable under the influence of gestation; and may also be the source of retrouterine hæmatocele during gestation. This was probably the case in the observation referred to in a subsequent page. In early pregnancy this varicose state of the utero-ovarian plexus can sometimes be made out by touch by the rectum.

Varices of the round ligaments were noticed by Haller. They occur at the root of the veins of this ligament. Sappey explains their origin as the result of the compression which the large veins experience in carrying the blood on to the heart.

3. Varices of the Anus and Rectum. Hemorrhoids.—These come under observation during gestation and labor. When they occur during gestation, Budin affirms, from close inquiry, that it is in most cases after attacks of constipation. We are inclined to think that he underrates the influence of the high vascular tension and the general engorgement of the pelvic vessels so characteristic of gestation. One might *à priori* expect that the hemorrhoidal veins, which are so apt to become varicose even in the non-pregnant, would become so under the great and rapid vascular turgescence of gestation. And this we believe is the case. Piles more or less distressing are very common even amongst primigravidæ. The influence of constipation, however, is very great. Duret describes a system of *derivative veins* which carry off the excess of blood from the proper hemorrhoidal veins when under pressure. Thus, he says, during normal defecation the blood is retained in the hemorrhoidal vessels—these become turgescent; but at the moment when the sphincter relaxes to let the fecal mass pass, the blood, submitted to high pressure, runs away quickly by the canals of derivation into the external hemorrhoidal veins, and thence into the system of the vena cava inferior. On the other hand, when the subjects are constipated, it is not only because the fecal matters compress the vessels of the rectum that hemorrhoids are produced, but especially because the unhappy patients make violent efforts, and these efforts bring about in the vena cava, and especially in the internal hemorrhoidal veins, a considerable distention of the venous walls. Moreover, since most frequently the straining efforts are abortive, the sphincter does not dilate, the canals of derivation are imperfectly opened, and thus the stagnation of the blood in the internal hemorrhoidal veins is increased; and this particularly in their network and ampullæ. Fordyce Barker says diarrhœa has the like effect. Attacks of diarrhœa and tenesmus provoking frequent straining may bring the same mechanism into action.

Piles occasion serious distress during pregnancy. Sometimes they bleed to a serious extent. Fatal cases are reported.

It is convenient in this place to complete the history of hemorrhoids by describing briefly the *influence of labor*. At the moment of labor, hemorrhoids are frequently seen starting from the anal orifice. A series of conditions favorable to the production or aggravation of hemorrhoids come into action. The head driven down presses upon the walls of the rectum and the walls of the pelvis so as greatly to retard the circulation and dilate the hemorrhoidal vessels. This dilatation is increased under the expulsive efforts. When the fœtal head distends the perineum there is direct pressure upon the hemorrhoidal veins; there is even complete opening of the anus, so that the rectal mucous membrane is exposed, and the dilated veins are seen sometimes as true ampullæ gorged with blood as if ready to burst.

Treatment.—Immediately after labor the hemorrhoids may return into the rectum; but in not a few cases it may be some days before the return is effected; and during their retention outside there is usually a degree of strangulation, with swelling and pain.

In the event of laceration of the perineum during labor threatening to involve large hemorrhoidal vessels, an incision of the perineum on one side should be made.

The necessity of avoiding constipation is universally recognized. During gestation we have found nothing superior to the compound liquorice powder of the German Pharmacopœia. It should be taken regularly, so as to cultivate and keep up the habit of daily relief. Fordyce Barker earnestly cautions against the use of castor-oil, insisting that it promotes the formation of piles. Acting on his advice we have never given it of late years; but it is possible that the greater care lately brought to bear on the preparation of the oil may have deprived it of its irritating properties. The watery extract of aloes with belladonna is a most useful aperient. We cannot speak favorably of the mineral waters so much in fashion. But they are sometimes useful in accelerating the action of the other medicines specified.

In case of great turgescence, with strangulation of piles, leeches have been resorted to. We have arrived at the conclusion that leeches should be discarded. They are unintelligent animals, refusing sometimes to bite when desired; the quantity of blood drawn is uncertain; and they may be unclean animals, possibly sources of infection. Scarification with a clean lancet is in every way to be preferred. The lancet does exactly what is wanted, and in the best and safest way. Barker advises forcible stretching of the anus under anæsthesia after the expulsion of the child, to facilitate the reduction of protruding hemorrhoids.

4. Varices of the Urethra and Bladder sometimes occur. They have been carefully described by Winckel and by Skene.

5. Varices of the Trunk.—Occasionally varicosities are observed near the breasts, and on the abdominal walls and gluteal regions.

In conclusion, it is well to bear in mind the common conditions which reign over all the forms of phlebectasis: the increase of the blood-mass, the high nervous and vascular tension, the general tendency to venous and capillary turgescence. We must seek in this relation for the guide in treatment. Salines, sedatives, digitalis, bromides, and gentle aperients will almost always be useful; and in severe cases venesection should be resorted to. This remedy is of supreme efficacy in lowering vascular tension, and thus in taking off injurious or dangerous pressure.

Progressive Pernicious Anæmia.—A clear case of this dire disease has been related by J. J. Bischoff.[1] In a young woman, badly nourished, very

[1] Correspondenz-Blatt für Schweiz. Aerzte, 1879.

soon after conception severe pains came on in the abdomen; she fell off in strength; some hemorrhage occurred, excessively offensive. At the end of a month she presented the aspect of intense anæmia; there was œdema of the legs; pulse 96, temperature 38.2° C.; breath very offensive; sullen behavior. Remains of ovum removed from fornix vaginæ. Then swelling, loosening, and infiltration of the gums followed, with some bleeding from the mouth. Vomiting, failure of digestion. There was no enlargement of spleen, no rigor, or such rise of temperature as would suggest septicæmia; and the loss of blood was too small to account for the anæmia. She sank about six weeks after the presumed date of impregnation. Autopsy showed œdema of lungs; numerous punctiform ecchymoses in both ventricles; the left heart contained a very little thin pale-red blood, with pale-red clots; same in right heart; the heart was enlarged; some fat-spots. Kidneys extremely anæmic; spleen not enlarged. All the appearances ended in those of extreme anæmia, justifying the conclusion that an antecedent oligocythæmia, which caused little distress in ordinary conditions, proved pernicious under the first trial which the organism had to endure.

Leucocythemia is an affection of the blood which is apt to arise under gestation. The principal features are fairly represented in the summary of three cases narrated by R. Paterson.[1] Two were primigravidæ; vomiting was excessive in the early months; towards term there was increasing sallowness or yellowness of the skin; no bile in the urine; then came enlargement of the liver and spleen, then swellings of the glands of the neck, rising pulse, hectic. The labors were natural, children alive, robust; great hemorrhage followed. A few days later rapid change for the worse set in; the skin was hot and tawny; the enlargement of the spleen, liver, and lymphatics greatly increased. Death occurred in the two primiparæ from asphyxia, due to swelling of the glands of the neck. Red globules were as one-fourth of leucocytes. Paterson cautions to look out during pregnancy for the sallow skin and enlargement of the spleen and liver, and to examine the blood by microscope.

The Lungs.—Asthma is liable to great aggravation under the trial of gestation and labor.

Hemorrhages.

From the alterations in the blood and in the circulating organs to hemorrhage the transition is natural and easy. Under high arterial tension and capillary congestion the blood breaks bounds. The more commonly described hemorrhages of gestation, those which are associated with the ovum and uterus especially, will be described in a distinct chapter. The hemorrhages we now enumerate are those which break out in other parts of the body, remote from the seat of gestation. These may be classed as—(1) hemorrhage from mucous membranes; (2) from the skin; (3) into serous cavities; (4) into the tissue or substance of organs, as the brain, eye, lungs, kidney, liver, spleen.

Hemorrhages on the surface of mucous membranes are at once the most common and the least hurtful. As Trousseau remarked, all physiological hemorrhages take place from mucous membranes. Extending this dictum, we may affirm that many of the hemorrhages observed in the course of gestation have a direct physiological purpose; that if they break out on mucous surfaces, they are for the most part conservative in their tendency, reproaching the physician who has abjured the lancet; that if they break

[1] Edin. Med. Journ., 1870.

out in serous cavities, or in the structure of organs, the design is not the less conservative, but from *error loci* is too apt to be injurious, or even fatal.

We have seen many instances of hemorrhage from the *alimentary canal* during gestation, either by vomiting, in the form of melæna, or of florid blood by the rectum. Hemorrhoids not uncommonly bleed at this period. But we refer to cases in which the blood was traced to a higher part of the alimentary tract. Sometimes the loss has been considerable, producing deep anæmia. We have also seen cases of effusion into the *bladder;* and the liability to hemorrhage from the kidney in the prealbuminuric and albuminuric conditions has been already pointed out.

Hemorrhage into the bronchi and smaller bronchial tubes is not uncommon. Such cases naturally excite serious alarm. Hæmoptysis is almost another expression for phthisis. But we have notes of several cases in which very free hæmoptysis recurred in successive pregnancies, ceasing with the pregnancy. One case may be specially cited. We saw a young lady in May, 1872, then six months pregnant for the first time. Hæmoptysis began at this time; she had blood in the mouth every morning; it was frothy and florid. There was some increase of intensity of the respiratory sounds in both lungs, no expiratory murmur; palpitation, slight anæmic souffle; the hands and feet swelled. Under digitalis this subsided a little, but not completely until delivery. She has had four children since, and the same symptoms recurred each time. During gestation the sphygmographic tracing showed unusually high tension. She is now, after ten years, quite strong, showing no indication of phthisis.

Bleeding from the nose is not very uncommon.

Subconjunctival hemorrhages are not rare. We do not remember to have seen bleeding from the free surface of the conjunctiva; the seat is in the conjunctival layers or in the subjacent connective tissue.

To this order of hemorrhages strictly belong effusions from the mucous membrane of the upper part of the vagina and the cervix uteri. This region is not only subject to the general vascular tension which prevails throughout the system, but is directly within the area of the special blood-attraction, of which the developmental focus is the uterus. But these hemorrhages will be more particularly described in connection with abortion and the uterine hemorrhages of gestation.

It is worthy of remark that similar hemorrhages from mucous membranes are observed under the analogous condition of menstruation.

Thus Nature points the way by which undue vascular tension may be relieved. These hemorrhages act for the most part as safe regulators of the dynamic machinery of the circulation. Failing this, or equivalent modes of regulation, there is imminent danger of internal hemorrhages or of other catastrophes.

Hemorrhage from the *skin* has been observed in the form of oozing; but more frequently from the bursting of varicose veins.

Hemorrhage in the form of *purpura hemorrhagica* occurs when smallpox complicates gestation.

Hemorrhage into *serous cavities.* We do not call to mind examples of hemorrhage into the pericardium or pleuræ, but we have known considerable effusions take place into the peritoneum. The source of the blood has been the utero-ovarian plexuses, which give way just as a varicose vein may under high tension suddenly exaggerated. In one case an effusion took place rapidly about the seventh month of gestation; it became encysted, and the gestation went on to term. When labor came on, a firm tumor behind the lower segment of the uterus obstructed the head; presently a large compressed clot was expelled through an opening in the roof of the vagina.

This roof had yielded under the expulsive efforts of labor. The woman made a good recovery.

Bernutz relates a case of *hemorrhage into the peritoneum* attending acute jaundice in a pregnant woman. The hemorrhagic tendency of this dife disease will be dwelt upon further on.

Hemorrhage from the bursting of a tubal or other ectopic gestation-sac hardly comes under consideration here.

Hemorrhage into the *serous cavity of the brain*. Although this may occur independently of albuminuria, this connection is especially to be considered. We refer to the section on "Albuminuria and Apoplexy."

Pulmonary Apoplexy.—Under similar conditions, effusions of blood may take place into the substance of the lungs. Probably in some cases the first effusion is into the smaller bronchial tubes and air-cells; but these are broken down, and then the blood invades the parenchyma of the lungs. We have seen this in cases where there was no suspicion of tubercular mischief; but in other cases there was chronic lung disease.

Placental apoplexy, which offers points of analogy with lung apoplexy, will be noticed under "Diseases of the Placenta."

Hemorrhages into the Parenchyma of Organs.—The propositions just stated regarding blood-effusions into the serous cavity of the encephalon apply, perhaps, *à fortiori*, to hemorrhage into the substance of the brain. Still, a certain proportion of cases are associated with embolism. It is true that thrombosis and embolism are especially *post-partum* affections. Simple hemorrhages analogous to those which we have seen to occur from mucous and serous surfaces are more characteristic of the quality of the blood and of the dynamics of the circulation obtaining in pregnancy. This hemorrhage into the brain-substance may occur:

1. Under an excess of the ordinary high tension during gestation. We have seen fatal apoplexy thus caused at three months.
2. Under the temporary strain of the expulsive stage of labor.
3. Under a complication of hypertrophy of the heart, or of other affections modifying the quality of the blood or the dynamics of the circulation.

Serous or Watery Discharges.—During gestation it is not uncommon to observe watery discharges from the vagina. These mostly come from the cervix uteri, some from the decidual cavity probably; and in the advanced stages of gestation they may be the result of oozing through, or rupture of, the membranes of the ovum. These discharges are commonly spoken of under the name "*hydrorrhœa gravidarum*." The hypertrophied glands of the cervix may throw off a considerable quantity of watery fluid in a short time. Without entering upon a critical discussion of the several theories offered in explanation, we will briefly state that the three sources named above seem to be well established.

1. The Discharge from the Cervical Canal.—In one case under our close observation, hydrorrhœa, to the extent of a pint or more daily, occurred during the three later months of gestation. This certainly came from the cervix. Other cases in non-pregnant women afford proof that the cervical glands may secrete large quantities of watery fluid, and that there is generally no necessity to seek higher up for the source. This cervical secretion is analogous to the salivation and pyrosis of pregnancy. The entire glandular system is more active in pregnancy, and the glands of the cervix uteri are especially developed, besides being within the range of high vascular activity.

2. The Decidual Origin.—Dubois says hydrorrhœa is the result of loosening of the membranes from the uterus, when the vessels pour out serum. This theory probably holds good in some cases of hydrorrhœa in

the later months. But in the earlier months we believe the view of Hegar[1] is truer. This observer describes the glands of the mucous membrane as being found in the decidua at the sixth month of gestation, and argues that their sudden disappearance in the subsequent months is improbable. In a case of hydrorrhœa he found in the decidua vera, at the beginning of the eighth month, an enormously developed glandular body. At the bottom of this morbid growth was a general hypertrophic condition of the decidua and its glands. These gave out the excessive secretions. In a case related by Graef,[2] the patient suffered during the last three months from repeated watery discharges, the uterus rising and falling with the gathering and escape of the fluid. The membranes were found without rent. He regarded it as a case of catarrhal hydrorrhœa.

In the above cases, 1 and 2, the fluid differs from liquor amnii.

3. Fluid escaping from *the amniotic sac.* We have stated that under pressure fluid may *transude* through the membranes. Certain it is that in many cases of free hydrorrhœa, which could not be referred to the cervical glands as the source, the membranes remained intact; and it is in strict accordance with hydrostatic laws that membranes permit of this rapid oozing. In some cases another explanation is at hand. The amnion may form under the chorion several layers, leaving spaces between filled with serous fluid. The outermost may burst, yielding their contents, the inner layer of the amnion remaining intact until labor. Preparations in most museums exhibit this laminated structure of the amnion. And again, in some cases the entire membranes may really burst prematurely, and yet labor may not ensue directly.

4. The fluid may come from *hydatidiform degeneration of the ovum.*

5. From *cauliflower excrescence* of the vaginal portion.

These discharges may be very puzzling. They raise suspicions of abortion or labor. The doctor is sent for, urged by the plea that "the waters have broke." If, on examination, he find the os uteri closed, or but little open, he may procrastinate; and still more so if by ballottement he finds the child still floats in the uterus, and there be no active pains, he may usually go home and wait in peace for another summons. An examination should in all cases be made.

The "*hydrorrhœa puerperarum*" will be described in the proper place.

Serous Metrorrhœa.—Chassinat[3] refers, under title, to a discharge of thin transparent yellow fluid at an earlier or advanced period of gestation, Ruysch, Röderer, and Dance thought it due to rupture of lymphatic vessels, or of hydatids of the uterine neck or fundus; Stuart, Böhmer, and Sigwart thought it escaped from a second abortive ovum; Delamotte and Cruveilhier from a cyst near the ovum; Caseaux from the space between amnion and chorion. Astruc, Deleurye, Puzos, Gregorini, P. Dubois, Devilliers *neveu*, and Nägelè from the inner surface of the uterus, that it is secreted externally to the ovum. Dubois says this hydrometra is the result of loosening of membranes from the uterus, when vessels pour out serum.

The quantity is usually greater than that of the liquor amnii; it is odorless, and like blood-serum, or like serous effusions in peritoneal sacs. The appearance is not adverse to continuance of pregnancy.

Disorders of the Alimentary Canal.

We may first complete the history of the "watery discharges" by referring to the cognate discharges from the alimentary canal. To begin with

[1] Monatsschr. f. Geburtskunde, 1863. [2] Jenaische Zeitschrift, 1865.
[3] R. Chassinat, Gaz. de Paris, 1858: M. f. G., June, 1860.

salivation. The salivary glands are often conspicuous for their activity amongst the other glands which exhibit an excess of energy during gestation. Some increase of saliva is common. But occasionally these glands seem to be inordinately excited, becoming a focus of secreting energy. When once an action of this kind is set up in a particular part of the secreting apparatus, a concentration of energy seems to be determined to it, so that the process acquires force and permanency. The quantity of fluid thus discharged is at times very serious, enough to affect the system. In moderate amounts it may be regarded as a natural derivative and evacuant, regulating the blood-mass, and thus the nerve and vascular tension. But like so many other natural processes in pregnancy, the equilibrium is easily lost. A lady came to consult us, holding under her shawl a pint mug as well as a supply of handkerchiefs. These were in constant requisition. She assured us that she filled the pint mug several times a day. The parotid and submaxillary glands were swollen and tender. She was much emaciated and anæmic. She was about five months pregnant. She had been under steady treatment in Birmingham without effect, and we were hardly more successful. The remedies tried were opiates, bismuth, kino, and other astringents, borax, chlorate of potash, belladonna.

The fluid discharged as saliva may come partly from the pancreas and stomach.

The salivation of pregnancy differs from mercurial ptyalism by the absence of the fetor. The buccal mucous membrane is sometimes tumid and congested. The gums are rarely sore, spongy, or ulcerated.

Dewees relieved a case by strictly animal diet.

One principle of action is to set up a derivative flux, as by hydragogue cathartics. Creasote lotion has been useful.

Pyrosis.—Sometimes the *secreting energy falls upon the glands of the stomach*. This seat is determined probably by the nervous action which sets up vomiting. More or less serous mucus is almost constant under the influence of vomiting. But sometimes the quantity thrown off is very great, amounting to two or three pints or more a day. The subject is discussed as an attendant upon vomiting, and need only be mentioned here for the sake of classification.

Diarrhœa.—Sometimes the current of nerve and vascular energy is directed to the intestinal canal; and we have watery diarrhœa. This may in some cases be caused by irritant matter, under epidemic influences, or as the result of cold. It may be due to septicæmia, as when it attends incoercible vomiting. But in a certain number of instances the flux is of a physiological character in its origin.

These watery discharges, whether from the uterus, stomach, or intestinal canal, occur in obedience to the same laws as those which in other cases determine hemorrhages. In moderation they regulate nervous and vascular tension; in excess they assume the character and entail the danger of disease. They may so far exhaust the strength as to make it necessary to consider the question of inducing labor. In our experience they rarely provoke abortion. Remedies that lower nervous and vascular tension, as digitalis, belladonna, bromides, may be tried. Bismuth, lead, opium, ipecacuanha, are occasionally serviceable, and we are often reduced to empirical treatment. Before resorting to the induction of labor, Copeman's method of dilating the cervix uteri should be tried; we have found it efficacious.

Constipation.—Apart from the disorders of the alimentary canal marked by discharges, we have to consider *constipation*, that troublesome attendant upon gestation. This is emphatically a disorder which should be counteracted by early care, if not anticipated. By exercise, diet, and mild aperients,

nemata if necessary, the daily habit of relief may be secured, and much evil may thus be avoided.

Affections of the Liver.

These affections, although imperfectly understood, occupy a prominent place in the pathology of gestation. We have seen that Tarnier describes a peculiar form of fatty change as a normal condition. This condition, which we ourselves have verified, differs so greatly from the ordinary condition of health, that, under any accidental increment of work, the boundary-line between physiology and pathology is easily passed. And the additional work thrown upon the liver is enormous. Excessive taxation of the functional capacity of the liver may result in disturbance of its great recognized duties: 1. The secretion of bile; 2, the glycogenic function; 3, the excretion of cholesterine.

Robin recognized two distinct parts in the liver, namely, a biliary organ and a glycogenic organ. Austin Flint[1] has proved experimentally the work of the liver in excreting cholesterine. It is probable that no one of these functions can be greatly disturbed without entailing disturbance in the rest. But it is necessary to study each separately.

1. The *biliary function*. This is the most frequently and the most easily noticed disturbance. We may note two principal forms: First, *simple jaundice;* second, *malignant jaundice*, so-called, that associated with acute yellow atrophy of the liver. The first is essentially functional; the second depends upon organic disease.

2. The *glycogenic function*. In like manner, the glycogenic function presents two principal forms: first, *simple excessive formation of sugar or glucose*, showing itself in the urine; second, a form in which the physiological balance is completely overthrown, and there is developed a condition analogous to severe *diabetes mellitus*.

3. The *cholesterine excretion* probably is liable to obstruction in various degrees. In the slighter, recovery takes place either by the liver pulling through its work, or by compensatory work by other organs. In the severer forms the system may break down under the variety of toxæmia which Flint calls cholesterænia.

It is hardly possible to imagine the liver struggling alone. All the secreting and excreting organs act in solidarity. So when the liver is oppressed, the kidneys especially feel the blow and suffer. Thus the blood-changes wrought by the liver disorder are complicated with changes due to defective or faulty action of the kidneys.

Simple Jaundice of Pregnancy.—This can be best illustrated by a typical case. A young lady, L. H., became pregnant immediately after marriage, and soon suffered much from vomiting. She had occasional bilious attacks, attended by constipation, pain in the right side, and sudden icteric suffusion of the skin, languor, depression, headache; icteric urine, no albumen. These attacks were always relieved by more moderate diet and saline purgation. The icteric tinge always remained more or less marked from an early period of gestation. Labor was effected normally on the 273d day after marriage. Child alive, healthy, showing no icteric symptoms. Lactation was also carried out healthily. On the tenth day after labor a free eruption of urticaria broke out, covering the trunk, arms, and legs. It disappeared in three days. This lady made a perfect recovery, and has had several children without complication. Here there was [illegible] functional

[1] Physiology.

disturbance of the liver. Ficinus[1] gives a case in which jaundice recurred in four successive pregnancies.

Another case exhibits the disorder in a different form. A young lady, A. C., had an abortion shortly after marriage. In her second pregnancy she suffered much from vomiting during the first five or six months. During the seventh month she was harassed by colicky pains and diarrhœa; crops of aphthous ulcers formed in the mouth; the mouth at times was so sore that eating was almost intolerable; she became emaciated and anæmic. The diarrhœa was greatly controlled by nitric acid, cusparia, and laudanum. She still further improved under the use of peracetate of iron. Nevertheless during the last month two or three fluid pale stools were passed daily, and the skin had a marked icteric tinge. She was delivered easily at term; child healthy. The very next day the stools, which had hitherto been white, consisted almost entirely of bile. She seemed relieved for a time, but soon febrile excitement set in, ending in violent mania. Under temporary seclusion she recovered perfectly, and has borne children since without trouble.

A distressing complication of jaundice is pruritus. The itching of the skin is sometimes intolerable.

The *treatment* of this form is simple. Alteratives, mercurial and saline, are indicated. Unless urgent symptoms occur, the question of inducing labor does not arise.

The following is a characteristic case of the so-called *acute yellow atrophy of the liver* not hitherto published. Mrs. J., æt. 35, was seen in consultation with Dr. Asher in 1863. She has had several natural pregnancies. Did not suffer much from sickness until the fifth month of the present pregnancy, then vomiting became at times very distressing, and was followed by jaundice and great prostration. On September 15, the icteric tinge was very marked; pulse 80; it had been more, and had varied in character. She was languid, prostrate, but still intelligent, answering questions. The uterus reached half-way to the umbilicus, was freely movable. The os was directed to the sacrum; position of uterus normal, not exercising any perceptible pressure anywhere. The stools had been scanty and clayey; the urine deeply tinged. The question of inducing labor was deferred. Next day there was considerable lethargy, but she put out her tongue slowly when told; she has not spoken; sits up in bed sometimes; pupils dilated, but contract on exposure to light. Some hours earlier Dr. A. reported that the pupils had been "remarkably irritable," contracting quickly on exposure. The jaundice was now more intense on the face and neck; not very marked on the hands and legs. She has not vomited much since last night. We decided to induce labor. The membranes were punctured. The liquor amnii that drained away was stained deep yellow. At 10 P.M. the jaundice had become more intense, coma more marked; some convulsive twitchings of the arms. On vaginal examination she manifested restlessness, and complained of pain. The liquor amnii had all drained off. The uterus had contracted on the embryo, but the os was tight, barely admitting the tip of the finger. No tenderness in region of liver complained of, and no part of the organ could be felt on pressing the fingers up under the cartilages. Ten ounces of urine drawn for examination. On the 17th, at 8.30 A.M., she was sinking, pulse 120. Icteric tinge still deeper, and more marked in the extremities; pupils dilated, still responsive to light, but feebly; coma deeper, occasional stertor; no evidence of uterine action. She died soon after.

There had been no cause known for mental distress, but she had from the

[1] "Zur Casuistik des Icterus gravidarum," Monatssch. f. Geburtsk., 1863.

first an unalterable conviction that her illness would be fatal. During the illness no blood passed by stool, but a week previous to the attack there was a large flow of blood by rectum; she had suffered from hemorrhoids. During the illness she repeatedly vomited bloody mucus in very large quantity. The onset of the disease was marked by languor and pain in the *left* hypochondrium, with itching over the skin. This was a month previous to the outbreak.

Dr. Letheby examined the urine, and reported: deep yellow green; turbid; deposited dirty yellow sediment; odor peculiar; very offensive; like a mixture of urine and putrid bile; sp. gr. 1018.2. It yielded 3.32 per cent. of solid matter; the residue had the character of a mixture of bile and urine extractive; it was very deliquescent; it furnished 0.78 of a white saline substance on perfect incineration. The ash was not alkaline, but consisted chiefly of chloride of sodium, with an alkaline sulphate and phosphate of lime. The urine itself was faintly acid; it gave characteristic reaction of bile with nitric acid; with strong hydrochloric acid it became rich green; with Pettenkofer's test it gave the rich red color. Microscopic examination showed that the deposit consisted of numerous fat globules, and transparent colorless globules of leucine, as well as numerous yellow globules of the same substance aggregated together, and consisting of concentric laminæ like small prostatic calculi. There were also numerous yellow globules of tyrosine, some quite smooth on the surface, and others covered with minute crystals like spicula from the surface; a large quantity of granular matter of a pale yellow also appeared. Large tufts of crystals of urea, and the peculiar form of common salt and urea were observed. On addition of hydrochloric acid the urine furnished crystals of uric acid in about the same proportion as normal urine.

The complete analysis of the urine gives this case a peculiar interest. The history is full enough to present a fair picture of the course of this dire disease. There was no reason to suppose that any serious disease of the liver or kidneys existed before the attack came on. The onset was not preceded by any premonitory symptoms, unless, indeed, the hemorrhagic vomiting and blood by stool shortly before be excepted. The gradually, but rapidly, deepening jaundice, the advancing coma, running rapidly and irresistibly to a fatal issue, are features that have been observed in other cases. The hemorrhagic disposition is characteristic. In one case retrouterine hæmatocele occurred. In two other cases seen by Robert Barnes, one in a young man, the other in a woman past the climacteric, which both ran a rapidly fatal course, the proximate cause was overwhelming mental distress.

Not to cite cases related in well-known works, we may refer to one reported in the "Lancet," 1874, which was observed carefully in the London Hospital, under Dr. Head. The general history is similar to the foregoing. The urine presented similar characters. A fœtus of eight months' development was born dead. It presented no appearance of jaundice. The labor was normal, no unusual hemorrhage. The edge of the liver could not be felt even on deep inspiration. She died in coma. A peculiar value attaches to this case because the necropsy was performed by Dr. Sutton. There were numerous hemorrhagic spots scattered through the skin. The scalp, skull, and dura mater were bile-stained, but not deeply so. The pia mater was healthy, not very noticeably bile-stained. The gray matter of the convolutions was paler than natural; in other respects healthy. The white substance looked normal. There was a small quantity of bile-colored fluid in the lateral ventricles. The pleuræ were bile-stained only. The lungs were congested, otherwise normal. The bronchial tubes contained a quantity of blood-stained mucus, and their mucous membrane was stained with bile. There were some

small hemorrhagic extravasations on the pericardium, it was also bile-stained. The right ventricle contained some yellow bile-stained clots and fluid blood. The left ventricle was contracted; a little blood was extravasated into its endocardium, and its wall had a dirty reddish-yellow appearance. The muscle was very easily torn, evidently abnormally softened; and one aortic valve was somewhat thickened. The peritoneum was healthy, only slightly blood-stained. The liver was not seen on cutting through and folding back the abdominal walls; but on drawing down the coils of intestine, it was observed shrunken, and lying up under the ribs against the diaphragm. When removed it was seen much smaller than natural, and much thinner from above downwards; it was very flaccid, and folded by its own weight over the hand. It weighed 1 lb. 15 oz. There were many old adhesions uniting its peritoneal covering to the diaphragm and adjacent abdominal walls. Its surface was smooth, and of a pale reddish-yellow color. On section its substance for the most part had a Turkey rhubarb-like yellow appearance; almost all signs of lobular structure were lost. Here and there, however, were portions that seemed more healthy; in some parts the intralobular veins were distinct; and here also were some minute blood extravasations. The liver-substance was not softer than natural, nor indurated. The gall-bladder was almost empty; it contained one or two teaspoonfuls of greenish mucoid substance; examined by Pettenkofer's test and nitric acid, it gave no evidence of bile. The microscope showed recognizable lobular arrangement; and although the minute biliary ducts seemed smaller than natural, yet their outline was distinct; the liver-cells were greatly altered, broken down, almost completely disintegrated, and in their place was a larger quantity of granular débris. There were many granules, which permitted light to pass readily through their centre; so-called fat granules; also some yellow, seemingly bile pigment. The fibrous matrix was very distinct. The capsule was for the most part normal; but from its under surface a number of corpuscles were seen extending into the liver-substance, looking as if some new growth were going on at the time of death. The *spleen* was about the normal size, certainly not enlarged. Some old adhesions united it to the surrounding walls and tissues. When cut into, it was seen very pale, much softened. The *kidneys* were bile-stained, and about the normal size. A few blood extravasations were found in the mucous membrane of their pelves. In other respects these organs were healthy. The *stomach* contained a quantity of "coffee-ground-looking" fluid, and this and the mucus were with difficulty washed off. Blood extravasations were seen in the mucous membrane. The *uterus* was large; its walls thick. It was not firmly contracted. Its lining membrane was pulpy, and coated with small blood-clots. The *fœtus* weighed 5 lb. 14 oz. Its skin was not yellow; the membrana pupillaris still existed. The body was well nourished. The liver occupied the usual space; it was purple, apparently healthy. All the other viscera were healthy. The fluid in the pleural sacs and peritoneum seemed to be blood-stained.

Dr. McDougall[1] relates a case of acute yellow atrophy, demonstrated by shrinking of the liver during life, and post-mortem observation, which presented some peculiar features. The subject was delivered of a healthy boy; the placenta was united to the uterus by firm adhesions, small abscesses being scattered over its surface. The patient had complained of languor and intermittent jaundice; occasional vomiting for two months before delivery; incipient phthisis revealed itself after labor; she became comatose; petechiæ appeared on the skin; urine showed leucin and tyrosin. The long continuance of the disease or its slow development, and the appearance of

[1] Edinb. Med. Journ., 1872.

leucin and tyrosin only after the stage of liver atrophy had set in, are remarkable.

In twenty-one cases occurring during gestation collected from Oppolzer, Frerichs, Scanzoni, Spaeth, Kiwisch, Roper, Wilks, Mall, Hecker, Braun, V. Haselberg, Grainger-Stewart, Paul Davidson, Head, and myself, the age ranged from seventeen to forty-two, no age seeming to be specially prone or exempt. The majority of the patients were primigravidæ. The period of pregnancy when the jaundice appeared was, in one case, the third month; in three, the fifth; in five, the sixth; in six, the seventh; and in three cases, the ninth month. In the majority of cases there was a history of severe mental disturbance preceding the attack. In almost all the cases abortion set in. In almost all hemorrhage from the uterus, as well as in other forms, occurred. All in which the history is complete were attended towards the close by coma, delirium, convulsions, or other symptoms of brain disorder.

The pressure theory so constantly invoked to explain the disorders of gestation has been called in here also. It is unequal to the occasion, and the occurrence of the disease in the third month is enough to exclude it. The disease, moreover, occurs in non-pregnant women and in men.

Virchow observed jaundice in one pregnant woman in whom a tight-lace lobe of the liver, together with the gall-bladder, was turned up in such a way that a stoppage of bile necessarily resulted from the tension of the bile-ducts. J. P. Frank met with a case in which a fatal rupture of the gall-bladder took place during labor.

The participation of the *kidneys* is noted by Spaeth, Hecker, Frerichs, Grainger-Stewart, and Paul Davidson, who found fatty degeneration of this organ. Sutton, however, found the kidneys essentially healthy. The peculiar changes in the urine, the disappearance of the urea, the temporary occurrence of albuminuria, point at any rate to trouble in the work of the kidney. The *spleen* is generally enlarged.

In connection with this history we must take note of the peculiar fatty change described by Tarnier as common in pregnancy, and of observations made by Hecker[1] under the title, "Contributions to the Knowledge of Acute Fatty Degeneration in Puerperal Women and New-born Children." He thought he was in a position to affirm that puerperal women are liable to a disease running rapidly, even suddenly, to death soon after labor, the symptoms being obscure without jaundice or intestinal hemorrhages, and only recognized as acute fatty degeneration on dissection, the basis of which was laid in pregnancy. Dr. McDougall's case, cited above, appears to be an illustration of Hecker's views.

Trousseau observes that "the diminution in volume of the liver is all the more remarkable, that a great many cases occurred in women pregnant seven, eight, or nine months—a stage of gestation at which we know that there is a notable augmentation in the size of the liver, irrespective altogether of any morbid condition." He further says, "The German school has erred in applying the term '*atrophy*' to this alteration of the cellules; and Charles Robin has done well to point out that there is *destruction*, and not atrophy, with or without change in the volume or consistence of the liver." He agrees with Budd in the opinion that toxæmia is the starting-point. The poison may enter from without; it may be analogous to that which engenders typhoid, or its source may be in the individual.

Hecker insists upon the simultaneous affection of the heart, liver, and kidneys. He says the disease is acute parenchymatous inflammation of the liver. He contends that there is toxæmia, and that albuminuria is constant. There was no albumen in Robert Barnes's case.

[1] Monatssch. f. Geburtsk., 1867.

It is of deep interest to make a comparative study of jaundice in the pregnant woman and in the new-born infant.

What is the cause of the coma and delirium which attend the latter stages of the disease? Is it the circulation of the bile-matters in the blood? Frerichs says he has convinced himself by a long series of injection experiments that the presence of the constituents of bile in the blood is harmless. Leucine has been several times found in the blood. But Frerichs does not take into account cholesterine. We think it probable that the brain symptoms are dependent upon the circulation of this substance and of urinary excretions in the blood.

The altered condition of the blood is shown by the almost universal occurrence of hemorrhage in the form of epistaxis, by vomiting, by stool, or from the uterus. The effusion of blood from the uterus is probably a main factor of the abortion which has been so constantly observed. Nor is the effusion of blood confined to the mucous membranes. It is sometimes seen under the skin. It is seen in the form of ecchymoses in the parenchyma of various organs—for example, in the kidney (V. Haselberg), in the liver (Mall), under the pericardium (Grainger-Stewart).

The *fœtus* is not necessarily affected. It has been born of natural appearance, and, in some cases, jaundiced. The liquor amnii has been observed deeply icteric. It was remarkably so in Robert Barnes's case. It stained the boards of the floor on which some fell.

We submit that the sequence of events most conformable to observation is as follows:

1. The high vascular and nervous tension which underlies all the phenomena of gestation. 2. The accumulation of excrementitious stuff in the blood resulting from inability of the excreting organs to keep pace with the work thrown upon them. 3. Impaired nutrition of the tissues, especially of the excreting organs and of the nervous centres, increasing their incapacity for work. 4. Exudation of albuminous matter in the liver and kidneys, with tendency to fatty degeneration of the epithelium of the secreting surfaces. 5. Some sudden intervening commotion of the nervous and vascular system, physical or psychical, which, increasing the strain upon the damaged kidneys and liver, intensifies the toxæmia, so that all the consequences of suddenly suppressed excretion break out.

The theory of inflammation of the parenchyma needs proof.

Treatment.—The question of highest interest is: Are there any antecedent morbid conditions necessary to the development of this disease, which can be recognized at a stage when their removal by treatment is possible? When the disease is once fairly started, so far as we can see at present, nothing avails to arrest its fatal course. One of the most striking and discouraging features of the disease is the suddenness, or at least the insidiousness, of its onset. It may be supposed that this suddenness of invasion, often apparently caused directly by some severe mental shock, is evidence that the disease arises suddenly without any particular predisposing conditions. But this reasoning should not be accepted too hastily. Nothing can exceed in apparent suddenness the outbreak of some cases of uræmic convulsions; yet it is almost certain that a particular condition of the blood and of the kidney already existed without which the sudden explosion would not have taken place. The discovery of the pre-albuminuric stage in the kidney affection by Mahomed suggests the hope that an analogous pre-icteric or pre-cholesterænic stage may be detected, and give warning for effective treatment. Research for this discovery must be directed to diligent analysis, chemical and microscopical, of the feces and urine, and to close clinical observation of all the functions. We are much inclined to believe

that the first factor is the altered constitution of the blood in the pregnant state; the second, the overpowering of the working capacity of the liver; the third, the circulation in the blood of the secretory and excretory products of the liver; and the fourth, the organic change in the structure of the liver. It will probably be found that the retention of cholesterine in the system plays an important part in the process.

If we could get a reasonable suspicion of what was coming before the stage of organic change, the induction of labor might avert the danger. When the disease is pronounced, it is too late to take this step.

The general history of the disease shows that a very large proportion of the total cases of acute yellow atrophy of the liver occur under the influence of gestation. Dr. Bardinet has even described an epidemic of this disease which occurred at Limoges, attacking thirteen pregnant women. Other similar epidemics have been described. This strongly indicates the expediency of cutting the gestation short, if the proceeding could be adopted in time.

In summary, it may be stated that icterus in pregnant women is observed in two forms: (1) The simple, without fever or cerebral symptoms. This is sometimes described as *icterus catarrhalis*. This form does not generally lead to abortion. If of long duration the child suffers. (2) The icterus with febrile and cerebral symptoms, that of acute yellow atrophy.

Glycosuria; Mellituria; Diabetes. The study of this affection, on account of its physiological relations, follows that of jaundice. We have already described the glycosuria which keeps within apparently physiological bounds; we have now to sketch the history of the affection when it has passed over into the domain of pathology. This proposition may fairly be laid down as the basis of the study. The train which leads up to the pathological development is laid in the normal conditions of gestation. The beginning may be traced in the association between the ordinary fatty change of the liver described by Tarnier, and in the development of the breasts and the preparation for the secretion of milk. The researches of de Sinéty, previously cited, establish a relation between the formation of milk and the appearance of glycosuria. This relation is sometimes alternative. We must also bear in mind the phenomenon of glycogenesis in the fœtus established by Bernard. This physiologist demonstrated that sugar appears in the placenta very early in fœtal life, and in the third or fourth month has attained its maximum. At about this time, when glycogenic matter begins to appear in the liver, the glycogenic organs of the placenta become atrophied, and are lost at some time before birth. His observations were made on fœtal calves. Epithelial cells filled with glycogenic matter are found in the placenta.

Apart from pregnancy, glycosuria is more rare in women than in men.

We do not know of any trustworthy data from which it could be shown what is the numerical relation of diabetes in pregnant women to women not pregnant. In our experience diabetes out of pregnancy occurs most frequently at the climacteric; and in some of these instances the morbid process may be a remanent from pregnancy.

Dr. Matthews Duncan[1] has collected the published cases of diabetes complicating gestation, adding several others, the sources of some of which are not given. "The histories comprise twenty-two pregnancies in fifteen women, varying in age from twenty-one to thirty-eight years. So far as is known all, with one exception, were multiparæ. In some, death occurred by collapse rather than by coma. Of the twenty-two pregnancies, including

[1] Obstetrical Transactions, 1883.

those going to term and those ending in miscarriages, in fifteen mothers, four ended fatally after delivery, premature labor having been induced in one of these to avert death before delivery. These four were puerperal deaths in point of time. Hydramnios was frequent, and in one case sugar was found in it; in another its observed stickiness make its saccharine character probable. In seven of nineteen pregnancies, in fourteen mothers, the child died during the pregnancy, having in all of these reached a viable age. In two more the child was feeble and died a few hours after birth, making an unsuccessful result in nine out of nineteen pregnancies. In one other case the child had diabetes. The dead fœtus is sometimes described as enormous, or its weight is extraordinary, and this probably arises from dropsical infiltration, as in one case recorded."

A case related by Bennewitz[1] is especially instructive. Diabetes appeared during the fourth, fifth, and sixth pregnancies. It disappeared after each pregnancy. The fifth child was premature and born dead, weighing twelve pounds. On one occasion blood was drawn. It formed an abundant dark-red crassamentum without siziness, and a clear serum of a peculiar faintly sweetish smell and taste. The urine about this time contained two ounces of saccharine matter per pound.

It is much to be regretted that we possess such scanty information as to the state of the blood in these cases. The influence of pregnancy in originating, or at least in evoking, diabetes is manifested in Bennewitz's case and in others. That the condition arises during pregnancy, and disappears after pregnancy, is conclusive evidence that it is started under physiological processes which, under abnormal strain, merge into pathological conditions. In the discussion on Dr. Duncan's memoirs, Dr. Robert Barnes drew a parallel between the histories of albuminuria and glycosuria in pregnancy, for the purpose of showing that just as albumen was frequently found in the urine of pregnant women without entailing any grave symptoms, and quite passed away with the pregnancy, so it was in the case of sugar or glucose; in both cases the physiological boundary might be passed, and then the gravest accidents might occur. It might be regarded as a question of individual tolerance or accommodation whether in any given instance pathological phenomena were developed or not.

To dissociate the pathological cases from the physiological cases is to disregard the clearest teachings of clinical observation, to close our senses against the most luciferous experiments instituted by Nature for the demonstration of this great problem.

Is there a pathology of diabetes? In other terms, is the rise of diabetes always a physiological error or cause, and not depending upon tissue-change? Dickinson affirms that diabetes is associated with, even depends upon, organic changes in the brain. Pavy contends that whatever the organic changes found after death, the primary condition is a chemical fault. We feel confident that a careful study of the physiological and pathological diabetes in the pregnant woman will confirm Pavy's proposition.

In the interesting discussion held at the Pathological Society in 1883, several pathologists brought forward specimens demonstrating lesions in several organs. Dickinson especially stated that to rough examination "the brain passed as natural, although it was generally hard in texture, often injected, and more rarely marked with extravasated blood on the surface. On section, pores, in a cribriform arrangement, exaggerating the ordinary puncta vasculosa, were often conspicuous in the centrum ovale, and the white matter underneath the lateral ventricles. In parts presenting such

[1] Reported in Edinb. Med. Journ., 1828, and cited by Duncan.

peculiarities to the naked eye, the microscope usually showed dilatation of the bloodvessels, extravasation of blood in a small amount, enlargement of the perivascular spaces, and alterations in the perivascular sheaths and nervous matter bounding the cavities. The walls of the cavities were often superabundantly sprinkled with grains of blood-pigment; and in many cases the nervous matter at their surface was rendered translucent and gelatinous by some degenerative change."

Dickinson urges against the opinion that the changes in the brain seen in diabetes were the result of the circulation of morbid blood, the testimony of clinical experience, that the disease continually began as the consequence of a mental impression or cerebral state, than which there was no fact with regard to diabetes better declared. This argument is strengthened by the experiments of Claude Bernard, in which he produced glycosuria by irritating the floor of the fourth ventricle.

Dr. Pavy has conducted elaborate series of experiments supporting the proposition, that in the liver, by an action of the same nature as that which moves the carbohydrates from one to another in the carbohydrate group, they were, under certain circumstances, carried out of the group altogether, and converted into some body which was insusceptible of being converted into glucose by sulphuric acid. When carbohydrates were taken by a healthy person, they were converted, not into a glucose, but into a dextrine, or maltose, and subsequently carried out of the carbohydrate group altogether. This was the process of assimilation of the carbohydrates in a healthy person; but in diabetic persons this power was lost; starch and sugar in them were converted into glucose, and appeared in the blood, from which it was eliminated by the kidneys. For this to occur there must be a glucose-forming ferment. Such a ferment existed in the liver, but only under certain circumstances. When the blood was supplied with blood which was thoroughly venous, it converted carbohydrates into maltose; but if the blood was imperfectly venous, or partook of the nature of arterial blood, the resulting body was glucose. It could be shown by a number of different methods that an excess of oxygen in the portal blood led to glycosuria. He was convinced that this excess of oxygen was due to a dilatation of the arteries of the chylo-poietic viscera brought about by vaso-motor paralysis.

Does heredity or diathesis enter as a factor in the development of this disease? Several considerations point to the affirmative. Glycosuria in pregnancy bears idiosyncratic features. It may be that like chorea, ague, and other affections, a latent disposition is evoked under the peculiar conditions of gestation. This speculation would bring into mutually supporting contact the anatomical and the chemical theories of the genesis of the disease. It is reasonable to conjecture that, as in the case of chorea, a structural change in the nervous centres may be an essential factor, lying dormant and unsuspected until pregnancy puts the organism to the test by starting the high nervous and vascular tension and other characteristic changes. Under the gestation process the preëxisting latent alterations in the nervous centres no doubt become accentuated, and thus we get those marked changes which are manifested after death.

The Prognosis of glycosuria which has passed the physiological boundary is grave both for the mother and child.

The Treatment must be regarded as doubtful. We have little evidence upon which to base a rational therapeusis. The great question which arises in all the grave complications of pregnancy is as to the induction of labor. The answer, as in these other cases, is also doubtful. In Aubrey Husband's case, cited by Duncan, Robert Barnes was consulted as to the expediency of

inducing labor. Could we get timely warning of the advance of the disease there might be an opportunity of arresting it by cutting short the pregnancy. But too commonly the disease will have drifted on to a perilous degree before the indication is seized. We must look to the development of chemical science for prophylactic or remedial resources. Such may be discovered by the assiduous pursuit of investigations based upon the plan of Dr. Pavy, aided by well-devised experiments upon pregnant animals. In the meantime the therapeusis must be based upon the principles recognized in the case of diabetes not complicated with pregnancy.

The Spleen.—There is little to add to what has been said about the spleen in the chapter on the "Process of Gestation," and incidentally in connection with albuminuria and disease of the liver. One condition, however, deserves note. It is the remanent enlargement after ague. This will be considered when the relations of ague and gestation are described.

The Kidney.—The more common changes in this organ have been sufficiently described in connection with albuminuria. It remains to take note of the occasional occurrence of *pyelitis*, and of the structural changes in the organ acquired before a pregnancy begins. Whilst it is certain that a "severe attack of albuminuria, with or without eclampsia, may leave the kidney perfectly sound, it is equally certain that the foundation of kidney disease is occasionally laid in this way. And granular disease may have been produced in other ways. In any case, when gestation is superadded, the kidney disease is liable to exacerbation. No complication can be more unfortunate than that of pregnancy and Bright's disease. Just as we should apprehend an untoward issue of the major operations of surgery in the subjects of this disease, so we may fear that the course of gestation will not run smoothly. In such a case, the risk run by mother and child is so serious that we can rarely hesitate as to the expediency of lessening the danger to the mother by bringing the gestation to an end. This done, the kidney is relieved *pro tanto*, and treatment directed to it will be pursued under more favorable conditions.

The Bladder.—The most important affection of the bladder during gestation is its distention under retention of urine, due to retroversion of the uterus.

Retention if prolonged entails congestion, inflammation, sometimes even exfoliation of the vesical mucous membrane; then there is the liability to retrograde obstruction to the function of the kidneys leading to pyelitis and urinæmia.

A frequent affection is irritability of the bladder, amounting sometimes to incontinence. This is due to pressure of the enlarged uterus, and in some cases to alterations in the character of the urine, as lithiasis, uric acid, and glycosuria.

These affections will be more conveniently discussed in connection with the cause—that is, retroversion.

Simple cystitis in early gestation is rare, but Monod[1] has observed and collected cases. The disease is marked by great pain in micturition, especially in expelling the last drops, sometimes by blood appearing in the urine; viscid mucus is almost constant; hypogastric pain increased by pressure; and febrile movement. In some cases cold acting upon a mucous membrane in a state of intense physiological hyperæmia may have been the cause; in some it is not improbable that gonorrhœal infection has extended up the urethra to the bladder.

The serous membranes and connective tissue may be the seats of serous effusions. These arise mostly in connection with albuminuria, as already

[1] De la cystite chez la femme, 1880.

described. But not seldom œdema or anasarca occurs without albuminuria, under the influence of pressure retarding the return of blood by the veins, of heart disease, or of hydræmia.

The skin is often the seat of pathological conditions, either the immediate consequence of gestation, or revived or exacerbated by the gestation. The increased activity of the glandular system has been referred to as a physiological condition. Under this influence the growth of hair is generally stimulated; and sometimes to an inordinate extent, so as to give rise to the term "*hirsuties gestationis*." Dr. Slocum relates an example:[1] a woman, in three successive pregnancies, grew a beard on the sides of the face and chin. It always began with the pregnancy, with itching.

Pruritus may be general, or chiefly localized in the pudenda. It is often intensely distressing, destroying rest, and compelling the sufferer to scratch the part. Under this treatment the epidermis is often torn, and bloody puncta are seen. Sometimes *eczema* seems to be the immediate cause of the pruritus; but in many instances no visible alteration exists. The distress is traceable to glycosuria, to jaundice, to irritating ingredients in the urine, and sometimes it can only be explained on the hypothesis of peculiar nervous irritability. A cure was effected in one case by smoking a cigarette daily.

Psoriasis is rarely generated by pregnancy, but where it already exists it is almost certainly aggravated.

Herpes Gestationis is described by Dr. Liveing.[2] He says it is rare; that it is a disease of neurotic origin characterized by an eruption of small bullæ and excessive pruritus. Wilson has described cases under the name of herpes circinatus bullosus. D. Bulkley, of New York, described nine cases. The bullæ leave dark-purplish or brown-pigment spots on the skin; it does not usually disappear immediately after labor. In a case by Liveing, bullæ were interspersed with hard, solid papules. It broke out after labor and during lactation.

Pemphigus.—Klein[3] relates an extreme case lasting three months. It ended in complete recovery after delivery. The husband was not syphilitic.

Pityriasis.—Startin had seen one form of pityriasis in pregnant women only. We have seen several cases.

Chloasma Uterinum.—Hebra and Kaposi[4] describe, under the head *Chloasma symptomatica*, the pigmentary affection observed under the influence of menstruation and gestation. They state that the chloasma patches are sometimes confounded with pityriasis versicolor. We sometimes meet with a brownish pigmentation on the face, which extends over the whole forehead as high as the level of the hairy scalp, and is either of a uniformly yellow or dark-brown color, or presents isolated paler spots here and there. The streaks do not always take a horizontal course, corresponding with the wrinkles on the forehead, but are not infrequently oblique, irregular, scattered, or run from one frontal eminence to the other. In other cases, the dark pigmentation is confined to two symmetrical patches, between which the skin remains of normal color. They frequently arch over the eyebrows. Sometimes the skin of the upper or lower eyelid is tinted a peculiar brown, giving the expression of sickness or suffering. In many persons the whole of the skin of the face is covered with a dark chestnut-brown, which extends to near the angle of the lower jaw. The areola round the nipple and the linea alba are especially liable to pigment patches and streaks. That all these pigmentary changes are the result of physiological changes may be

[1] New York Med. Record, 1875.
[2] Lancet, 1878.
[3] Allgem. Wiener medic. Zeitung, 1867.
[4] Diseases of the Skin. N. Syd. Soc.

inferred from the facts that they never make their appearance before puberty; that in many they only appear during menstruation and pregnancy; and that, with the cessation of these conditions, the pigmentation fades or disappears.

Swayne describes ("Obst. Trans.," vol. iv.) a remarkable case of discoloration of the forearm during pregnancy.

The Breasts.—The intense physiological hyperæmia and the acute development of the gland-structure may run into acute inflammation. Mastitis is much more frequently observed after labor, but we now and then see cases during gestation. In the early months some engorgement, induration, and tenderness are not uncommon in primigravidæ of delicate constitution and of imperfect skin and glandular development. Imperfection of the nipple may be a cause. Cold or injury is sometimes urged. But we believe that, in some cases observed by ourselves, lascivious manipulation was to be accused. We have seen inflammation go on to abscess. The treatment will be the same as in post-puerperal mastitis.

Diseases Grafted Upon the Gravid State.

Amongst the most important of these are the class of zymotics: as typhoid, typhus, variola, relapsing or famine fever, scarlatina, rubeola, erysipelas, cholera, yellow fever, diphtheria, ague.

It may be stated as a general proposition that gestation confers no immunity against zymotic diseases. But we believe that gravid women are less susceptible to infection than the non-gravid. The case is entirely altered from the time of labor. In puerperæ the susceptibility to invasion by zymotics is greatly increased. And we have seen reason to suspect that in gravidæ exposed to infection, the zymosis will not always be developed as under ordinary conditions. It seems that under the energy of high vascular tension, which concentrates the forces upon the work of structural growth, fermentation or germ-development is checked. The zymotic germs are either destroyed or thrown out of the system, or lie dormant, in latitancy as it were, until labor takes place. Then centripetal absorptive action sets in and zymosis is favored. Hence the frequent outbreak of fever often heterogenetic in puerpery. To take *typhoid* first. This complication is not very frequent. Considering the wide prevalence of typhoid at times, the comparative immunity of pregnant women is surprising. We are tempted to invoke a protective virtue in gestation. Baratte[1] collected 94 cases. He confirms others in the observation that it promotes a hemorrhagic tendency. The proportion of abortions ensuing was 57 or 60 per cent. In 62 cases collected by Duguyot (1879) there were 40 abortions. Of 42 children whose fate was noted only 5 survived. The prognosis is much worse for the fœtus than for the mother.

Gusserow[2] collected valuable data. He says typhoid is rare in pregnant women. In an epidemic at Bâle 83 per cent. ended in abortion, and at Vienna 58 per cent. This difference was ascribed to difference in treatment. He never found evidence of fever in the fœtus. Most cases of fœtal death occur in the second or third week of the disease, when high temperature rules. Severe hemorrhage is likely to attend abortion in the early months. He regards the induction of labor as a grievous error.

Variola.—The history of smallpox in its relations to pregnancy is full of

[1] Thèse de Paris, 1882. De la fièvre typhoïde dans la grossesse.
[2] Berlin. med. Wochenschr., 1880.

interest. The disease presents two distinct varieties for study: 1. The confluent, or pure variola. 2. The discrete, or modified variola. Then we have 3. The influence of vaccination simple.

Dr. Gayton, Superintendent of the Homerton Smallpox Hospital, has given us the statistics of this institution. He saw 9671 cases. Of this number 95 were in pregnant women. Of 29 women gravid at different stages, from 3 to 8 months, taken with confluent, semiconfluent, or hemorrhagic smallpox, 22 recovered, 7 died. Of 30 women taken with discrete smallpox, all recovered. Of 26 women with confluent, semiconfluent, or hemorrhagic variola, abortion took place in every case, 21 of the women perished, 5 recovered. Of 10 cases of discrete smallpox all aborted, 1 only died.

As to the offspring: In one case, in which the mother died undelivered at 8 months, the fœtus on autopsy showed no mark of smallpox.

Twins at 8 months, born of a woman who died, were stillborn, showing no mark of the disease; one child at 6 months was born alive, but quickly died, it bore doubtful marks; one child of 8½ months, born alive, quickly became cyanosed and died, it bore no evidence of smallpox; in one fœtus of 4 months, doubtful vesicles were seen on the chest; one child born at 8 months, lived 5 hours, bore no marks. Of the children of the 10 women affected with the discrete form, one of 8 months lived 24 hours, no evidence of smallpox; one of 8½ months lived 4 days, died of convulsions, no marks; one at 8 months, whose mother died of metritis, lived 8 hours; one child of 9 months at term showed no evidence of smallpox; it was vaccinated the day after birth, and again on the fifth day, both attempts unsuccessful; it stayed in hospital a month exposed to risk, and left with its mother quite well.

Serres[1] observed 23 abortions in 27 cases of variola. Chambrelent noted 4 abortions in 5 cases.

1. What is the effect of variola upon the gravida? *a*. The *confluent*, or hemorrhagic form, is, Gayton says, likely to be fatal whether the subject be pregnant or not. But we think the mortality is almost certainly greater than it would be in non-pregnant women. *b*. The *discrete* form seems scarcely more dangerous in pregnant than in non-pregnant women. It seems that the period of greatest danger is that of puerpery. It is probable that pregnancy tends to impart the hemorrhagic character to the disease.

2. What is the effect upon the pregnancy? Abortion is almost constant. Non-viable children aborted of course are lost, and so a large proportion of the total of embryonic lives perish. In others the child is stillborn, dying under influences which will be discussed hereafter. Some few, born at a viable age, die soon after birth. The children that survive are rare exceptions.

3. Are the children affected by the disease *in utero?* In an unknown proportion of instances the child is certainly attacked. Some resist vaccination and exposure to smallpox; some are born bearing vesicles or scars, showing that they have gone through the disease *in utero*.

Desnos, cited by Chambrelent, relates that a pregnant woman took smallpox. The stage of desiccation reached, she brought forth a healthy child which showed no trace of eruption. It resisted vaccination with lymph that succeeded with other children. Chambrelent relates a similar instance from his own experience. But Fumée, of Montpellier, relates a more remarkable case. The woman bore twins; one child only showed variolous pustules.

It is desirable to record examples observed by classic authorities in the prevaccination era, since in the present era simple cases cannot be frequent.

[1] Gazette Médicale, 1832.

In John Hunter's works (vol. iv.) is a very full account of the subject down to his time. He relates the following: "Mrs. Ford had been seized with shivering and the other common symptoms of fever, on December 5, 1776. She was considered to be in the sixth month of pregnancy. In the 8th smallpox appeared. She passed through the disease well, and was delivered on the 11st. An eruption was observed all over the body of the child, and several of the pustules were filled with matter. Dr. Leake had observed that it might be necessary to inquire whether those adults who are said totally to escape the smallpox have not been previously affected with it in the womb. The child was therefore seen by Dr. Leake, the two Hunters, Cruikshank, and Mr. Falconer, who all concurred that the eruption was the smallpox. Dr. Hunter said that in all the other cases of the same kind that he had met with the child in utero had escaped the contagion. Sir George Baker mentions[1] the case of two pregnant women who were inoculated at Hertford. They both had the smallpox favorably, and afterwards brought forth children perfectly healthy. Both children were inoculated at the age of three with effect. Dr. Watson relates[2] the following deeply interesting case: "A woman big with child, having herself long ago had variola, assiduously nursed her servant during the whole process of this disease. At the proper time she brought forth a healthy female child, on whose body Dr. Watson discovered evident marks of variola, which she must have gone through in the womb; he pronounced that this child would be free from infection. After four years her brother was inoculated, and also this girl, at the same time with the same pus. The boy had the regular eruption, and got well; the girl's arm did not inflame; on the tenth day she suddenly turned pale, was languid for two days, and got well. This case shows that the mother may carry the variolous poison to her child, herself being unaffected by it. She may be a simple carrier."

The late Mr. Streeter held that the fœtus, taking the disease from its mother, went through it at a distinct period—that is, the disease in the fœtus had its stages of incubation and eruption after the corresponding stages in the mother. He observed that the fœtus had only arrived at the incubative stage, whilst the mother was already maturing the vesicles.

Chambrelent's investigations[3] on the passage of figured elements through the placenta are of extreme physiological and pathological interest. He found that the microbe of the "choléra des poules" inoculated in pregnant animals passed to the fœtus, and that the blood of the fœtus, cultivated in Pasteur's fluid, and then inoculated into other animals, produced the disease in a fatal form.

"How is it," asks Chambrelent, "that in some cases the variola affects the fœtus in utero and fails in others?" He contends that the variolous microbe passes through the placenta, but that in some cases it finds in the fœtal blood a congenial medium for culture, in which cases the disease is produced, whereas in other cases the microbe finds a soil not suitable for culture, and then the disease is not produced.

THE EFFECT OF VACCINATION UPON PREGNANT WOMEN AND THE FŒTUS.—Precise data are not so copious as might be expected. Behm reports[4] 33 vaccinations of women pregnant in the eighth, ninth, and tenth months. Humanized lymph, for the most part, was used. In 4 cases the operation failed, in 22 it succeeded completely, in 7 partially. Of the 33 children, 25 were vaccinated successfully, the rest without success, but in 6

[1] Med. Trans., vol. ii.
[2] Phil. Trans., vol. xlvi.
[3] Recherches sur le passage des éléments figurés à travers le placenta, 1882.
[4] Centralbl. f. Gynäk. 1882.

of these the lymph was not good; one, on whom good lymph was used, failed. This is the only instance of presumed protection from intrauterine action. New-born infants, he says, experience less constitutional disturbance from vaccination than at a later period.

In 1870, Thorburn vaccinated several pregnant women successfully, and found no insusceptibility in their infants.

It has been proved by fairly numerous experiments that many of the children born of women who went through smallpox when pregnant resist vaccination, although they show no mark of having gone through the disease *in utero*. Thus there may be acquired immunity without having had the disease in its ordinary form.

Again, vaccination practised upon pregnant women presents analogous phenomena. Burkhard, of Bâle, revaccinated 28 pregnant women. In 4 of 8 cases tested the infants resisted vaccination.

Rikett and Roloffs, operating on sheep, inoculated variola in 700 sheep in the later weeks of gestation. Their young were inoculated four or five weeks after birth with the lymph of sheep-pox; the inoculation failed in every case, whilst it succeeded fully in thirty-six lambs whose mothers had not been inoculated.

M. Masse[1] states the following problem: "The species which now appear to enjoy a certain immunity may owe it to the fact that their ancestors have all been affected by the disease. Their actual immunity may be due to a vaccination which they enjoy by heredity."

Thus it may well be that the almost universal practice of vaccination through successive generations has been and is telling in (1) lessening the susceptibility of our children, (2) in diminishing the virulence of the smallpox—that is, in substituting a modified disease for the virulent disease which afflicted our non-vaccinated ancestors.

It is very interesting to examine *by what process smallpox excites abortion and kills the fœtus.*

In some cases the abortion follows the death of the embryo, but in many cases the child is born alive. We shall examine presently the evidence proving that the embryo or fœtus almost necessarily perishes if the mother's temperature be long kept up to 41° C. or more. We will now discuss the causes of its premature expulsion alive. In this case the abortifacient influence must be mainly if not wholly exerted upon the mother. The following propositions were stated by Robert Barnes:[2]

a. Nature hardly tolerates the concurrent progress of an active disease and pregnancy.

b. If the disease be of zymotic character, the morbid poison, aggravated by the further blood-poisoning resulting from arrested or disordered secretory function—so important in pregnancy—acts upon the whole system, producing fever, increasing the irritability of the nervous system, impeding the nutrition of the muscular system, including the most important muscle of all, the uterus, and directly irritating this muscle. The influence of blood poor in oxygen and loaded with carbonic acid, in causing contraction of the involuntary muscles, has been well established by Marshall Hall, Brown-Séquard, and others. It is a matter of experience that pregnant women suffering from asphyxia, chronic or acute, are extremely apt to abort. The blood in fever wants oxygenation. In this respect it resembles the blood in asphyxia. But superadded to this condition are the materies morbi, and other consequent blood impurities, which it is probable act in a similar

[1] Des inoculations préventives dans les maladies virulentes.
[2] "The History of Smallpox complicated with Pregnancy." Obst. Trans., 1868.

manner upon involuntary muscle. The result is that the uterus is directly stimulated to contract, and labor is induced.

c. There appears to be this difference between the action of acute and chronic blood-poisoning upon the embryo and pregnancy: in acute disease, where respiration is impeded and where the blood is rapidly poisoned, the first effect is upon the uterus. In chronic poisoning, as in the case of secondary syphilis, the embryo may be first attacked. Its nutrition is sapped, it perishes, and then, the uterine development being arrested, and involution taking its place, in the course of a period ranging from seven to twenty-one days contraction sets in, and the dead fœtus is expelled.

d. There is another way in which it is probable that abortion is produced in zymotic diseases. The blood is in a state favorable to extravasation. Apoplexy of the placenta or effusions between the placenta and the uterus take place, and thus uterine contraction is excited.

e. Abortion, or premature labor, may be excited in yet another way. The sudden impression upon the nervous system, or shock, may cause the uterus to expel its contents. We have seen this happen under the influence of an attack of apoplexy, and it is at least a principal factor in the causation of labor when uræmic convulsions break out during pregnancy.

THE EFFECT OF VACCINATION UPON PUERPERÆ.—This is a practical question. A woman was vaccinated[1] the day after labor. The milk dried up. The infant died from defective nutrition. A coroner's jury, reasoning that the sequence of events proved that they flowed as the effect of the vaccination, censured the doctor for vaccinating. Is there any danger in vaccinating or revaccinating a recently delivered woman? Without approving the censure of the jury, which was based upon entirely arbitrary assumptions, we believe there is. Any zymotic introduced into the working blood of the puerpera during the involution-process is likely to disturb the process and set up fever.

At the same time the question of vaccinating a puerpera must be governed by circumstances. If an epidemic of variola be raging, if the puerpera be living in a community herself exposed to risk of contagion, and thus liable to pass it on to others, vaccination may be justified.

Two practical questions arise—(1) Is it useful to induce abortion or premature labor in a woman suffering from smallpox, in the mother's interest? We think this must be answered in the negative. It is in a high degree probable that she will abort spontaneously. The process is in operation early, and there is no evidence to show that by precipitating the impending event any advantage is gained. (2) Does induction of labor offer a better chance of saving a child arrived at a viable age? We think the evidence of children born spontaneously and living, and of others in which the child is born dying or dies very soon after birth, lends weight to the opinion that timely induction of labor, by subtracting the child from lethal influences, would give it a better chance, and that without materially adding to the danger of the mother. In the section on the influence of high temperature on the fœtus *in utero* which follows, we shall find reasons strengthening this conclusion.

Is it useful to vaccinate pregnant women whom there is reason to think inadequately protected? This invokes the question: What is the effect of vaccination upon pregnant women? Dr. Yarrow, who has used good opportunities for testing this point, tells me that he never hesitates to vaccinate pregnant women, and that they experience no bad results. We cannot discover evidence of the mother being more prone to abort. Then, are the

[1] See Times, May 28, 1883.

children of mothers who were vaccinated when pregnant protected? The case is covered by that of smallpox. It has been found that some children thus born resisted vaccination; but, as might be inferred from the fact that some children whose mothers, when pregnant with them, were not thereby protected, so some children, probably most, of women vaccinated when pregnant will not be protected. The belief is, however, held by some physicians that the children born of mothers who were vaccinated whilst carrying them are protected. Still, vaccination may be properly applied as a test of protection; and for the public safety such children should not be exempted from the wholesome general law to vaccinate.

Relapsing or Famine Fever.—Murchison says that pregnant women invariably abort if attacked with relapsing fever, sometimes in the first, but oftener in the second paroxysm. Abortion is sometimes, but not invariably, a cause of death. Delivery is sometimes followed by copious hemorrhage, or by rapid sinking, and death; but, as a rule, the mother recovers. Even when pregnancy is advanced, the child is always stillborn, or only survives a few hours. Murchison submits that on the supposition that relapsing fever is but a mild variety of typhus, it would be very remarkable that in the former abortion is almost invariable, and the fœtus dies; whereas in typhus, abortion is the exception, and when it occurs the child, if near the full time, usually lives. Wardell, in the Scotch epidemic of typhus 1843–4, saw several cases in pregnant women, and remembers no case of abortion occurring.

Accepting the statements of Murchison, and our own observations are in accord, we may see in the reaction of the pregnant woman under relapsing and typhus fevers a test by which these fevers may be differentiated.

Scarlatina.—Opportunities of observing the complication of gestation with scarlatina are not rare. The complication is grave, although we and others have seen many cases in which the gestation went on to term without obvious injury to mother or child. It certainly increases the liability to abortion. This it may do in two ways: 1, by killing the child; 2, by setting up uterine action.

The late Dr. Woodman reported to us a case of a primigravida, æt. 18, who took scarlatina when 3½ months gone. It left her with a systolic mitral murmur. About six weeks before delivery chroeic movements, bilateral, very violent, set in. In the labor these became exchanged for eclampsia. She died after giving birth to a dead child. The urine was albuminous throughout. This case strongly suggests the conclusion that scarlatina, itself a disease that puts the kidney on severest trial, intensifies the risk of albuminuria. In this way the complication is especially to be dreaded. The danger is less in the case of women who have had a previous attack of scarlatina.

Do children born of women who had scarlatina during gestation acquire protection from the disease? Observations are wanting. The following case reported by Dr. M. Williams, of Liverpool,[1] proves that the disease may pass to the child *in utero*. A woman eight months pregnant took scarlatina from her children; she had had it before. It came on with vomiting. She desquamated and recovered. At term she was delivered of a fine girl, whose skin was desquamating. A week later the child had erysipelas, beginning at the navel; it subsided. An abscess formed on the left foot; it recovered.

Thorburn relates the following case: G. K., pregnant, was exposed to the influence of scarlatina. About a fortnight subsequently she was confined of

[1] Brit. Med. Journ., 1875.

a girl a little before the expected time. The child, when born, was covered with desquamative scales—no very rare occurrence—but in a day or two suppuration of the cervical glands set in, and the urine was for three or four days highly albuminous. A fortnight afterwards the mother was attacked by scarlatina, which ran a tolerably severe course. Both did well. Thorburn says: "I can hardly resist the conclusion that the fœtus received the poison and suffered its primary effects whilst yet unborn, the mother being then insusceptible, and that she afterwards, probably owing to the puerperal weakness, became susceptible and was infected by her own offspring."

If a woman take scarlatina near the advent of labor, then the outbreak of the disease appears to be suspended until after delivery. Then the blood degradation of the involution process of puerpery assumes more dangerous characters. It becomes one of the worst forms of heterogenetic puerperal fever. This will be discussed under the "Diseases of Puerpery."

The treatment must be conducted on the same lines as those which rule in the scarlatina of the non-pregnant. The chief special question is as to the induction of labor. Our opinion is, that under ordinary conditions the gestation should not be interrupted. But when the child being viable and living, the mother's life is in imminent danger, labor should be induced in the hope of saving the child. Again, if albuminuria be detected, labor should, as a rule, be brought on.

Cholera.—The terribly rapid course of this disease gives little time for the development or observation of the reciprocal action of it and pregnancy. We have seen two severe epidemics, but have no notes of cholera complicated with pregnancy.

The intense carbonization of the blood must dispose to abortion and to death of the child.

Four memoirs on the relations of cholera to gestation contain the greater part of the information we possess on the subject, namely, by Bouchut,[1] A. Drasche,[2] Baginsky,[3] and Hening.[4] Hening, from observations of an epidemic in Leipzig, concluded that the proclivity to cholera of pregnant women is not material, and that the mortality is less than that amongst the general population. Of 38 cases, 13 died. A larger proportion of women in the later half of gestation were seized. The greater number of deaths occurred on the third day of the disease. In the cholera hospital at Berlin, Baginsky reports the mortality at 61 per cent. He observed 23 pregnant women in cholera; 10 aborted, and 7 died without aborting. It may be presumed that some of the latter would have aborted had they lived a little longer.

Abortion or premature labor occurred in a large proportion of cases.

There was no special tendency to hemorrhage in the third stage.

The question of rapid delivery by the natural passages or by the Cæsarean section when the woman is moribund, or a few minutes after death, with the hope of saving the child, may have to be decided.

Diphtheria.—Of the influence of diphtheria upon pregnancy we possess no personal experience, nor are we aware of any very precise observations by others.

Rubeola.—Measles. This zymotic is very rare in pregnant women. Bourgeois in 15 cases noted 8 abortions. The disease did not appear to be aggravated. The child has been born bearing evidence of measles.

Influenza.—In 1837 an epidemic of influenza raged in Paris. Almost all the pregnant women in the Maternité were seized. Jacquemier thought

[1] Gaz. Méd. de Paris, 1849.
[2] Wein, 1860.
[3] Deutsche Klinik, 1866.
[4] Mon. f. Geburtsk., 1868.

that the course of gestation was not materially affected; but Cazeaux observed that abortion was more frequent.

Erysipelas.—The pregnant woman is not exempt from erysipelas; but there is little experience upon this subject.

General Considerations.—The apparent immunity of pregnant women from zymotic infection is partly explained by the fact that many have previously gone through these diseases. On the other hand, the comparative frequency with which puerperæ are affected indicates a renewal of proclivity to the development of the zymotics.

Montgomery and Ramsbotham insisted that pregnancy served to operate as a safeguard against infectious diseases; but, urges Ramsbotham, this immunity is more than counterbalanced by the unusual susceptibility evinced after delivery. He observed that during epidemics a zymosis ran through whole households, the mother, if pregnant, alone escaping; but that if she fell in labor before the infection had expended itself, she would almost invariably become attacked, and suffer more severely than the rest. We ourselves, like many physicians, have witnessed several instances of gravid women nursing their children assiduously through scarlatina, themselves escaping.

Ague.—Primary. Ritter[1] concluded that in malarious regions pregnant women rarely took ague, whilst puerperæ frequently did so during the first three weeks. It is a popular belief that pregnancy is protective against ague. This agrees with the theory we have enunciated, that under the high vascular tension of gestation the system is not prone to absorb from without; but that this proclivity is especially favored by the low tension and active absorptive power of puerpery.

The child *in utero* may take ague. The spleen of infants is found large in malarious districts.

It is found that the disease yields to quinine and arsenic, as in the non-pregnant subjects.

Ague disposes to abortion. Göth observed 46 women taken with ague; of these 19 aborted. The fits lost something of their ordinary rhythm. The uterine contractions of labor were irregular. The fits returned after labor. Several observers besides Göth and Ritter found that women who had escaped the fever whilst pregnant took it in childbed.

The Influence of Temperature of the Mother on the Fœtus.—High temperature attending acute fevers or disease in the pregnant woman induces increased rapidity of pulse in the fœtus, and if prolonged may even kill it. The limit of temperature compatible with the survival of the child seems to lie between 40° and 41° C.

Complicating conditions, as noxious matter in the blood, must be considered. The temperature may be only an exponent of septicæmia.

When the temperature keeps up to 40°, and the child's heart-beat is maintained at a high rate, the propriety of inducing labor to save it is indicated.

The influence of simple high temperature has been investigated experimentally by Runge,[2] who subjected pregnant bitches and rabbits to heat in a stove. He found that in one series of experiments, in which the temperature in the mother's vagina did not exceed 41°, all the fœtuses were born alive; in another series, in which the temperature exceeded 41.5°, the fœtuses died, especially if the temperature was kept up.

Kaminsky (1862)[3] having observed 87 women affected by typhus or re-

[1] Virchow's Archiv, 1867.
[2] Archiv f. Gynäkologie, 1880.
[3] Deutsche Klinik, 1866.

lapsing fever, came to similar conclusions. He said the prejudicial effect of high temperature of the mother on the fœtus was not alone noted in zymotic disease, but in pneumonia and other acute diseases. The heart-beats become masked, tumultuous, without rhythm, then disappear; the movements of the fœtus at first more frequent, then degenerate into convulsive movements and cease. On autopsy the fœtus shows ecchymoses in various parts; the brain, liver, spleen are gorged with blood; and the same lesions are found in the placenta. As a general rule, the expulsion of the dead fœtus only takes place some time afterwards; in typhus and relapsing fever it frequently does not take place until convalescence.

Kaminsky contends that the one constant factor in the effect wrought upon the fœtus *in utero* is the high temperature. He attributes minor influence to the blood-poison, to the cause of the ferment producing the rise of temperature. In 43 cases of pneumonia collected by Ricau, abortion took place in one-half, whilst only 2 aborted out of 13 cases of pleurisy. The difference may be explained by the comparatively high temperature of pneumonia.

Hohl (1833) observed that a low temperature of a woman during gestation and labor lowered the pulse-rate of the fœtus, and that a high temperature raised it. Hütter (1861) observed that the fœtal pulse responded to the mother's suffering from fever. Fiedler, in five cases of typhoid, observed that the fœtal pulse presented, like that of the mother, evening exacerbations and morning remissions. Kaminsky, in 1869, and Winckel, made further researches, and stated generally that when the high temperature had lasted a certain time the heart-beats were perceptibly increased, and that the pulsations of the fœtus and the temperature of the mother went *pari passu*. When the high temperature lasted a certain time the child was born asphyxiated or dead.

There is some evidence, hardly extensive enough to attest the conclusion, that high temperature in eclampsia may kill the fœtus.

The Diatheses, Original and Acquired.

First a few words may be said as to *struma* and *tuberculosis* (*phthisis*). When these exist the course of gestation may not be materially affected. Labor may take place at term and without special accident. But we have had many occasions to observe the proneness of strumous women to abscess of the breast and perimetric inflammation. Placentitis and calcareous change in the placenta are especially apt to occur.

Lungs; Asthma, etc. Tuberculosis.

Phthisis: its Relations to Gestation.

It was at one time thought that gestation gave immunity against phthisis. Scanzoni even favored this opinion. He examined the bodies of several hundred women who had died of puerperal fever and never found lung-tuberculosis. This negative reasoning is not conclusive.

Dr. Warren, in an elaborate memoir,[1] argumentative, statistical, and somewhat vague, collects the opinions favorable to this view. Amongst the authorities cited are Andral, Eberlé, Heberden, Chailly, Montgomery, Burns, Denman, Jacquemier, and Churchill. He concludes that gestation retards

[1] Amer. Journ. of Med. Sc., 1857.

phthisis by opposing sanguineous determination to the lungs, on the principle of derivation and revulsion. Larcher also says: "The heart driving the blood towards the fœtus, this is diverted from the lungs."

This theory of immunity is opposed by physiological history and by clinical facts. The negative evidence of Scanzoni falls before positive evidence. The theory of derivation from the lungs is fallacious; it is in direct contradiction to facts; the entire organism, including especially the mucous membrane of the lungs, feels the impulse of increased heart-pressure; it is more vascular. Rokitansky's argument that the lung is compressed is also fallacious. The fact of its compression is denied. Küchenmeister maintains that the lung capacity is increased. Certainly the lung has more work to do; respiration is increased in frequency. More excrementitious stuff is brought to it for elimination. Working under increased pressure, it may be expected, like other organs, to be more prone to disease. Thus Grisolle[1] gives the histories of 27 cases of phthisis occurring during gestation. In 24 of these it began during gestation. In none was the disease retarded; on the contrary, it made rapid progress. Dubreuihl also having examined the question clinically, rejects the theory of antagonism. Louis also rejects it.

We think precise recent experience will confirm this doctrine of Dubois (1860): that gestation may become the cause of numerous pathological conditions; that it aggravates most of those arising during its existence; and that it preserves from none. The whole history of the diseases attending gestation is illustrative of this text. De Cristoforis[2] says observation has shown the disastrous influence of gestation. He has many times seen women in the last trimestrium, with signs of advanced phthisis, become rapidly worse, fall precipitately into extensive pulmonary destruction, and hurried to death more rapidly than would otherwise be the case. The pulmonary congestion, one of the consequences of the superior mechanical arterial hyperæmia, explains this. The lungs become less pervious; serous infiltration ensues. These two conditions, added to that of the specific tubercular deposition, have for direct effect imperfect hæmatosis. Hence softening of tubercles is greatly favored. He says that autopsy showed œdema as well as tubercular deposition in the lung.

The relations of phthisis and surgical operations illustrate this text. Paget[3] says, "In all cases of acute or progressive phthisis great risk is incurred by almost every operation. The risks of the excitement, of many days of feverish disturbance, and of loss of blood, and of pain, and all such consequences of operations, are much above the average; to say nothing of the special chances of exciting pneumonia. I cannot doubt that I have seen patients whose acute phthisis has become more acute, and others in whom the early stages of phthisis were accelerated by the consequences of operations. The case is very different with chronic or suspended phthisis. These benefit by removal of a source of irritation.

Another related question is as to *the acceleration of phthisis after labor.* The affirmative is the general belief. Our own experience, which has been extensive, compels us to affirm: 1. That pregnancy confers no immunity against the invasion of phthisis. 2. That it exerts no retarding influence upon its progress. 3. That there is a rapid aggravation of the disease under the trial of puerpery.

What, on the other hand, is *the effect of phthisis upon gestation?* We have no distinct evidence that it promotes abortion or premature labor, unless indeed the disease is hurrying on the patient to death; then in the agony, or a little earlier, when carbonic acid is accumulating in the blood, the uterus is sometimes stimulated to contract; and so labor precedes death.

[1] Arch. Gén. de Méd., 1857. [2] Annali Univers., 1863. [3] Clinical Lectures.

THE EFFECT UPON THE CHILD.—The child, a true parasite, drains the mother for its own support. It is generally born well developed; and if, as Rokitansky says, it be true that it rarely shows tuberculosis, the disease is very apt to be developed later either as tuberculosis or as meningitis, peritonitis, or some other cognate disease. With regard to the placenta, we have repeatedly made the observation that tuberculous women are more prone than others to calcareous deposits on the placenta.

Still another question: *Should phthisical women be advised to marry?* On medical grounds the question is answered by the preceding statement. The health prospects of the woman, and that of her probable offspring, say, No. It has been supposed that such subjects are not prone to conceive. But in this opinion we cannot concur. We are tempted, statistics failing, to believe the contrary.

Sometimes phthisis is disguised under a severe and rapidly fatal pneumonia.

The syphilitic diathesis exerts the most disastrous influence during gestation, involving mother and child. The general affection of the mucous membranes embraces the uterine mucous membrane and the outcoming decidua. It may originate in primary sore, or by propagation of secondary or tertiary taint through the fœtus. The subject will be further discussed under "Abortion." We may here state that syphilis contracted from the fœtus presents, according to Hutchinson, the following symptoms: First, a peculiar cachexia marked by a pallid earthy complexion, loss of flesh, debility, great depression of spirits, and liability to aching pains in the bones on taking cold. This is often accompanied by some specific signs, as loss of hair, sores on the tongue, fissures at the angles of the mouth; eruptions of the tertiary form, as psoriasis, condylomata, nodes. It is remarkable that the cachexia sometimes occurs unaccompanied by any of the above specific marks; and this is especially the case in women who have conceived but once, or whose own powers are vigorous enough to enable them to resist to a great extent the influence of the poison. Such women date their illness from the pregnancy.

The rheumatic diathesis existing before gestation may also bear upon the placenta, disposing to fibrinous effusions in it. The chief effect, however, is pain. Naegelè and E. Rigby insisted much that the gravid uterus was liable to rheumatism. Kiwisch denied it. We are disposed to agree with Naegelè and Rigby. The affection is characterized by severe uterine pain during gestation.

Acute rheumatism during gestation is certainly rare, but unmistakable cases have been observed. One case became the topic of national interest; it culminated in a stiff knee-joint. When we reflect upon the hyperinotic state of the blood and other characters in pregnancy resembling those of acute rheumatism, we might expect the disease to be more frequent. When it occurs, the symptoms differ in no material respect from those observed in the uncomplicated disease. The danger of pericarditis is serious. If the fever is severe and the temperature very high, there should be no hesitation as to bleeding from the arm. The question of inducing labor will arise, but the propriety of its execution will be doubtful.

Bourgeois cites two cases of rheumatic arthritis in pregnant women; in one, in whom the rheumatism was acute and general, abortion took place. Grenser relates cases.[1] In one case the woman suckled, the rheumatism remitted for a few days, returned, and became chronic, lasting several months.

[1] Mon. f. Geburtsk., 1865.

Under the **neurotic diathesis**, original or acquired, we rank insanity, chorea, epilepsy, and ague.

Insanity, chorea, and epilepsy have been already described.

Ague.—In strictness, the place here assigned may be disputed. But remembering that the symptoms evoked are mainly neurotic, allied to convulsion, it is convenient and instructive to consider chronic ague in this connection.

In Robert Barnes's Lumleian Lectures instances are adduced of the awakening influence of gestation under latent malarial disorder. He infers that this action raises a strong presumption that ague exerts some persistent change of nutrition in the nervous centres; so that although a woman may for years have been considered cured, gestation, coming as a test, proves that the cure was only apparent, not absolute. A similar history is traced in the relations of traumatism. Thus Verneuil insisted that surgical operations resuscitated latent ague. Paget[1] says:

"Patients with ague bear operations as well as others of the same class; but in the course of their recovery they may alarm you by having one or more ague fits, exactly resembling those that precede pyæmia. And more than this: if a patient has ever had ague, and, even many years afterwards, you perform an operation on him, ague may seem to be renewed in him at some short time after the shock or loss of blood, or whatever other damage he may have sustained. I have so often noticed this, that whenever I hear of severe rigors following any operation, I ask for a previous history of ague."

This subject has been well studied by Dr. Billon.[2] Assimilating traumatism and labor he describes the ague diathesis or intoxication as *chronic impaludism*. In cases he cites, the ague fit was evoked in some during gestation, in some during labor, in others during puerpery. In some, again, the fits seemed suspended during gestation, in order to break out more violently after labor.

Involution of the uterus was not apparently retarded; the lochia persisted.

Désormeaux cites a case from Schweig: A woman pregnant six or seven months was seized with quartan; every time when on the point of a fit, the fœtus had tremulous movements, and after delivery the child had quartan ague.

Sir Thomas Watson relates a case of a woman who "had tertian, which attacked her, of course, on alternate days; but every other day, when she was well and free, she felt the child shake, so that they both had tertian ague, only their paroxysms happened on alternate days."

An important clinical point is not to confound the rigor, fever, and sweating of septicæmia, with the cold, hot, and sweating stages of ague. The main features of differentiation are the greater persistence of the symptoms in septicæmia, and the history of ague, and the periodicity of the attacks.

Quinine is, however, valuable in both cases. It may be useful to give it by subcutaneous injection.

[1] Clinical Lectures.

[2] Thèse de Paris, 1882.

CHAPTER XII.

ABORTION.

ABORTION may be regarded as an "accident of gestation." But the event has so many interesting physiological, pathological, and clinical relations that it demands special study. It is of the deepest importance to analyze carefully the causes remote and immediate which lead to the premature interruption of gestation. This study will throw a flood of light upon many problems that must otherwise remain unsolved, leaving the physician to grope blindly for true therapeutical indications.

Most of the conditions described in the previous chapters on the "Diseases of Gestation," "Complicated Gestations," and the "Accidents of Gestation," may entail abortion. In these chapters, therefore, a great part of the history of abortion has been written. What now remains is to complete this history; to set the subject forth in systematic order, to describe the process, and the prophylactic and therapeutic treatment.

Close clinical study of cases of abortion will establish one point much overlooked—abortion is, in many instances, a practical protest of the system against gestation. Pregnancy being a physiological test of the soundness of the subject, and the subject proving unsound or unequal to the strain, abortion is nature's resource. Hence we may draw the physiological corollary, that *abortion may be regarded as a conservative process;* and to this we may add the therapeutical corollary: The indications for treatment must be sought in the constitutional as well as in the local conditions.

Three factors have to be considered in the study of abortion: 1. The father. 2. The embryo. 3. The mother. The mother's state is a complex state resuming all three, in those cases especially where the father is the subject of certain diatheses or diseases.

Abortion may or may not be preceded by the death of the embryo.

Death of the embryo necessarily curtails abortion.

Definitions.—Abortion means the arrest of gestation at a stage antecedent to the viability of the embryo.

Abortion is complete when embryo and membranes are expelled.

Abortion is incomplete when the embryo is expelled, the membranes being retained.

Abortion is "concealed" (Stolz) when the embryo has perished, and the whole ovum is retained. This has been absurdly styled "missed abortion," for, as McClintock put it, every woman who is delivered at term may be said to have missed aborting.

Abortion is the scientific equivalent of the vulgar *miscarriage.*

"*Criminal abortion*" is the legal construction put upon the act of attempting to procure abortion for other than strictly medical reasons, and this whether the attempt be successful or fail.

To the popular mind the word "abortion" is likely to suggest the idea of wilful or criminal interruption of gestation. To avoid erroneous inferences by non-professional persons, it is therefore judicious to use the word "miscarriage." The unskilled also often speak of a "slight miscarriage," meaning a very early abortion. We shall use the term "abortion" only, understanding that it includes all cases of untimely death of the embryo.

Premature labor is distinguished from abortion by occurring after the embryo has attained viability, but is still immature.

"*Missed labor*" means the hypothetical retention of a mature fœtus in the uterus beyond natural term of gestation, signs of labor at the proper time having been manifested. All the presumed cases are resolved into "concealed abortions" or "ectopic gestations."

If we subject all cases of abortions to a broad theoretical analysis from an etiological point of view, we shall find that they may be distributed into two classes: 1. Cases in which the ruling cause lies in the mother. 2. Cases in which the ruling cause was derived from the father. In all cases it may in strictness be contended that, whatever the cause, it acts *through* the mother. But it is not the less true that in many cases the death-giving cause comes solely from the father. The ovum at the moment of fertilization receives from the male parent the principles of life and death. The female parent may or may not be affected morbidly through the embryo. Cases are not uncommon in which a woman has borne a series of aborted ova to one man, and living children to another.

For the purposes of description the analytical method is essential. We are compelled to take the causes of abortion separately in some kind of succession. But when we come to look at cases clinically, we shall often find it impossible to isolate the particular cause which brought about the abortion. In many cases the causes are complex; both paternal and maternal influences may be at work to produce the result. Nor shall we always be able to determine which influence was predominant. The causes specified in the following or in any classification will occasionally overlap.

Some theoretical light, which may be reflected upon the clinical features of the case, may be seen in the condition of the ovum and its involucra. It may be stated broadly, far from absolutely, however, that the impress of the father's fault will be more especially marked in abnormal states of the embryo itself and in its strictly fœtal envelopes, that is, in the amnion and chorion; whilst the impress of the mother's fault will be more especially marked in the maternal envelope, that is, in the decidua and maternal placenta. The diseases of the ovum, including the placenta, will be more conveniently described together under the "fœtal causes of abortion," since it is seldom possible to distinguish with precision the causes which begin respectively in the fœtal and maternal elements.

The reciprocal action between the pregnant woman and the embryo forms a subject of study necessary to the just appreciation of the causes of abortion.

Propositions: 1. The blood of the fœtus receives morbific materials from the blood of the mother. This would appear to be self-evident. The fœtus can only grow by what it receives from the mother, and must take what the mother's blood conveys. But this reasoning may be too absolute. It is certain that there exists at the point of contact of the maternal and fœtal bloods some discriminative property by which noxious materials may be arrested or converted. We cannot otherwise account for the fœtus resisting the variolous and other zymotic poisons, as undoubtedly happens. The placenta exercises a function analogous to that of the lymphatic glands, reducing or rejecting noxious stuff brought to it. This function is certainly limited, but it exists.

Experiments, however, prove that along with the healthy constituents, the maternal blood may carry other substances. Thus Flourens gave madder to pregnant animals; the bones of the embryos were colored with the pigment.

Majendie injected camphor and oil into the vessels of pregnant animals.

These foreign substances were quickly detected in the fœtus. David Williams, of Liverpool, performed similar experiments with like results.

Frerichs says that biliary matter in women suffering from jaundice is transmitted to the fœtus. Bonetus describes a fœtus born of a jaundiced woman, "*ita flavus ut e cerâ confectus puer, non partus humanus videretur.*" Similar observations were made by Wrisberg and Finke. But for this a long continuance of the jaundice is necessary. Frerichs says in jaundiced women who have aborted from five to fourteen days after the commencement of the jaundice, he has been unable to perceive any alteration in the color of the fœtus. In one remarkable and protracted case of jaundice persisting until the moment of parturition, the child was not affected.

Conversely, the blood of the mother may receive noxious elements from the fœtus. This also may appear to be self-evident. The mother's blood is the natural channel by which the waste products of nutrition in the fœtus are carried off. Savory, however, proved this by direct experiment. Opening the uterus of a pregnant sheep, he injected a minute dose of strychnine under the skin of a fœtus; in a very short time the mother exhibited evidence of strychnism.

Again, Hutchinson adduces evidence which seems conclusive that constitutional syphilis may be communicated to mothers by the agency of the diseased ova. Abraham Colles, Baumés, Egan, and Diday, affirm that, although abundant instances are known in which syphilitic infants having sore mouths have infected wet-nurses who have suckled them, yet not a single one is recorded in which the child's own mother has been so contaminated. Now, as mothers suckle their own infants far oftener than they employ wet-nurses, they ought, were their liability equal, to furnish a larger number of instances of sores communicated from the mouth to the nipple. Whence their immunity? Unless we admit that they have already received from the infant prior to its birth such contamination as it is capable of conveying, the problem is not solved. Balfour, Harvey, Langston Parker, Montgomery, confirm this doctrine of contamination through the fœtus. Parker adds that "when the father diseases the ovum alone, the mother in a great number of instances escapes."

To this we may add the remarkable fact observed by ourselves that a woman has borne healthy children to a first husband and abortions to a second.

Analysis of Causes of Abortion.—Bearing in mind that the analysis sketched below is open to the objections which apply to most pathological analyses, we may accept it as furnishing a useful provisional scheme of classification and basis of description, and as offering a rational clew to clinical investigation. The following table will serve as a classified index of the causes of abortion. These may first be divided into

1. Cases in which the determining cause lies in the mother.
2. " " " father.
3. " " " embryo.

ABORTION.

Maternal Causes.

I. *Poisons in mother's blood.*

1. Communicated—*Heterogenetic.* Fevers, malaria, syphilis.
   Gases as CO, CO_2.
   Mineral: lead, copper, mercury.
   Vegetable substances: ergot, savin.
2. Products of morbid action—*Autogenetic*; as in jaundice, albuminuria.
   CO_2 from asphyxia, and in moribund.
3. Anæmia, over-suckling, obstinate vomiting.
   Bright's disease, lithiasis, jaundice.

II. *Diseases disturbing the circulation dynamically.*
Some liver diseases, obstructing portal system.
Heart diseases, excess of vascular tension.
Lung diseases, thoracic and abdominal tumors.

III. *Causes acting through the nervous system.*
Some nervous diseases.
Shock, physical and psychical.
Diversion or exhaustion of nerve-force, as from vomiting. Reflex action.
Convulsion. Apoplexy.
(These last two act partly through asphyxia, producing CO_2 in blood.)

IV. *Local or pelvic disease.*
Of uterus, as inflammation, hypertrophy, tumors, diseases of decidua.
Mechanical anomalies, as flexions or versions of uterus, fissures of the cervix uteri, pressure of tumors upon uterus, or adhesions of uterus preventing its growth.

V. *Adolescent and climacteric abortion.*
Uterus immature (infantile), or
Uterus in atrophic involution (senile).

VI. *Artificially caused by violence.*
Blows, squeezing, puncture of uterus, injury to ovum.

Epidemic abortion.

Sympathetic abortion.

FŒTAL CAUSES.

I. *Diseases of ovum.*
Primary or secondary upon diseases of maternal structures or blood.

II. *Diseases of embryo, generally causing its premature death.*
Faults of development.
Diseases of nervous system.
Diseases of kidney.
Diseases of liver.
Diseases, general, as syphilis.
Mechanical, as torsion of cord, or anything causing death of embryo.

HEMORRHAGE.—Many of the causes, maternal and fœtal, entail *hemorrhage*. This may be an *apparent* cause of abortion; it is the first objective note of what is going on. But we can hardly imagine a pure primary hemorrhage. There is an antecedent cause for the hemorrhage which is probably the real cause of abortion.

Maternal Causes.—1. POISONS IN THE MOTHER'S BLOOD, COMMUNICATED OR HETEROGENETIC. Foremost in this group rank the zymotic fevers—variola, scarlatina, typhus, typhoid, rubeola, cholera, diphtheria, erysipelas, malaria. The abortifacient influence of these diseases has been described in the chapter on the "Diseases of Gestation." To that chapter we must refer.

The immediate factors of abortion in fevers are chiefly the following: 1, irritation of the uterine fibre by the specific fever poison carried to it by the mother's blood, exciting the uterus to contract, proved by occasional expulsion of a living embryo or fœtus; 2, irritation of the uterine fibre by hypercarbonized blood, the result of the zymosis and of imperfect respiration; this may also act primarily upon the uterus; 3, high temperature of the mother. We have seen (p. 343) that the embryo almost invariably perishes when the temperature rises above 105° F.; 4, the embryo may be poisoned by the fever poison. In the two latter cases, the embryo first dying, abortion necessarily follows.

2. DIATHETIC DISORDERS OR POISONS, AS INHERITED OR SECONDARY SYPHILIS, STRUMA, TUBERCULOSIS. Primary syphilis may be classed with

the *heterogenetic poisons*. A chancre acquired during gestation is far less likely to lead to abortion than is the secondary or chronic form of syphilis in the mother, or the secondary or tertiary form in the father. When the mother is suffering before impregnation from secondary or tertiary syphilis, the uterine mucous membrane, out of which the decidua and maternal element of the placenta are developed, is liable, like the mucous membrane of the throat and the skin, to be diseased. Hence the fœtal nidus being tainted, the ovum is badly nourished, the placenta is apt to degenerate, and abortion ensues. This will be more fully discussed under "Diseases of the Placenta."

The proneness to abort varies. In women who themselves have been the subject of primary syphilis, the proneness to abort is very great. Not so in the case of women infected through the embryo. In these, as Hutchinson notes, the fœtus derives its morbid constitution from but one parent, and in all probability from one who has himself nearly worn out the tendency. It is evident that a fœtus begotten by a father who suffers only from constitutional taint, and nourished in the womb of a healthy mother, excepting insomuch as she may have received contamination from itself, has a very fair chance of life. It is a fact that the vast majority of syphilitic infants are born healthy-looking, and show no sign of disease until from a week to a fortnight old. The most probable explanation of this is that in the vast majority of cases the mother is healthy and the father diseased. Receiving, therefore, while *in utero* an abundant supply of well-elaborated nutriment, the fœtus lives and thrives, there being no need for the exertion of its own organs of assimilation; but after birth it loses this advantage, and with a constitution enfeebled by its taint, is compelled to digest its food, and to aerate and elaborate its own blood. Hence the speedy manifestation of the hitherto latent disease. In those cases in which the fœtus is born dead, with the skin peeling or covered with eruption, it may be inferred that either the mother has herself had primary disease, or has by repeated pregnancies become saturated with the tertiary taint.

Struma and *tuberculosis* may also affect the uterine mucous membrane, preventing the construction of a healthy placenta, and so promote abortion. Apart from this mode of action, to which we think we have traced some cases of abortion, it does not appear that these diatheses or phthisis are frequent causes of abortion.

Noxious Gases.—We know most of the abortifacient influence of *carbonic acid* and *carbonic oxide*. Breslau narrates[1] an instructive example. Two women slept in a room in a lying-in hospital into which gas was suffered to escape. Both were deeply poisoned, rendered insensible, and the fœtus of one was killed. It had been proved to be alive the day before. It was expelled dead next day. The gas was the product of the destructive distillation of wood; it contained a large proportion of carbonic oxide.

In one of the Algerian campaigns it is told that many hundreds of Arabs who had sought refuge in caves were suffocated by lighting fires at the mouths. Many of the women were found to have aborted.

We have also been able to trace abortion to the action of *sewer-gas*.

1. Metallic Impregnations.

Arsenic.—Dr. du Vivier[2] treated two pregnant women for psoriasis with arsenic. Both aborted at seven months of dead children. Dr. A. Guérin observed similar consequences from giving mercury. But under moderate

[1] Monatsschr. f. Geburtsk., 1859.

[2] Annales de Dermatologie, 1869.

doses not long continued we do not think abortion is very likely to be induced.

LEAD.—M. Paul[1] from inquiries in type foundries, found that 4 women had 15 pregnancies: of these 10 ended in abortion, 2 in premature labor, 1 in stillbirth, and 1 child died in 24 hours. In a second series, 5 women had borne 9 children before working at lead, and had had no abortions. After exposure they had 36 pregnancies; of these 26 ended in abortion, 1 in premature labor, 2 in stillbirths, and 5 children died, 4 in the first year. A woman had 5 pregnancies all ending in abortion; she left the business and bore a child. A woman having left the business had 2 children, she returned to it, and had 2 abortions. In other observations M. Paul made out that like bad effects follow when only the father works in lead. These observations have only the force of crucial experiments.

In the case of *mercury* an interesting history is given by Ad. Lizé.[2] He observed the influence of this metal upon work-people engaged in the hat manufacture, in which mercury is used. He classified cases in three series: (1) in which men were exposed to exclusion of their wives. Of 10 pregnancies 2 issued in stillborn children, 3 children died in early infancy, 5 survived in a sickly condition; one born before the father worked in mercury was healthy; (2) husbands and wives both exposed: 14 pregnancies issued in 5 births at term, 5 children stillborn; 2 died before third year, 4 before five years, remaining 3 in doubtful health; (3) women only exposed: of 7 pregnancies, 3 ended in abortion.

In many cases in which the child happens to be born alive, its constitution is deeply impaired, and it often dies young.

These observations on metallic poisoning suggest several inquiries of extreme interest. If we can accept the presumption that in those cases where only the husband was exposed the poison acted from him, the mother serving only as a vehicle, we have evidence of paternal transmission similar to that which we possess in the case of syphilis. This is a point rich in physiological and pathological applications. It must, however, be remembered that the woman, living in close contact with a mercurialized man, could hardly escape contamination by other processes. These cases give strong evidence in favor of the pre-natal treatment of the fœtus where it is presumed to be diseased. Further observations are needed in this direction.

IRON has often been accused of causing abortion. The belief in its abortifacient properties lingers in the minds of some medical practitioners. Our observations, based upon long experience of the action of iron on pregnant women, is decidedly contradictory to this opinion. It may be true that a large dose of some forms of iron may excite such disturbance that abortion may follow, but, as a rule, its action is beneficial; it counteracts the anæmia so common in pregnancy; and thus conduces to prevent abortion and to lessen the risk of hemorrhage in labor.

In connection with iron a few words may be usefully stated as to the presumed identity of ecbolics, emmenagogues, and abortifacients. It is a popular belief prevailing amongst lawyers, and to some extent countenanced by medical men, that agents reputed to have the virtue of provoking menstruation will also provoke abortion. Although there may be a substratum of truth underlying this assumption, nothing can be more unscientific. The causes of amenorrhœa and of abortion are manifold; they frequently differ in nature; and so the agents that may be effective in inducing the one may utterly fail in inducing the other. It is extremely important rightly to appreciate the distinction. Criminal charges have been based upon the ad-

[1] Arch. Gèn. de Médecine, 1860. [2] Union Médicale, 1862.

ministration of iron in medicinal doses, regardless of the fact that iron is strongly indicated in the anæmia of pregnancy to prevent abortion.

Vegetable Substances.—Savin, ergot, quinia, pulegium.

Savin may provoke abortion if administered in very large doses. Lethe by relates a case.

Ergot has undoubted power to provoke uterine contractions; but in the case of a healthy pregnancy the action of this drug is very uncertain. It frequently fails in the hands of the physician when there is a medical indication to anticipate the normal advent of labor. The subject will be referred to when describing the methods of inducing labor.

Pulegium, or pennyroyal water, has, we believe, no effect whatever.

Generally it may be stated that irritant medicines administered in decidedly irritant doses may produce abortion. In this way strong purgatives in drastic doses may act. But even in cases where abortion follows upon the administration of such doses, there is probably a preëxisting tendency to abort. It may be laid down as an axiom: That *the healthy ovum clings to the healthy uterus with wonderful tenacity.*

2. Products of Morbid Action: Autogenetic.

Next to poisons invading the body from without, we find a class of poisons generated in the mother's system. Such poisons arise in jaundice, albuminuria, in slow asphyxia from heart and lung disease, and in rapid asphyxia from brain diseases, as apoplexy, and generally in the moribund. In the ordinary forms of *jaundice* which occur in pregnancy, unless attended by severe vomiting, abortion, or premature labor, so far as I have observed, is not common. In malignant jaundice or the acute yellow atrophy of the liver, abortion is almost certain to occur. The entire organism is profoundly deranged. A hemorrhagic tendency is engendered; effusions are seen in various parts of the body, and uterine hemorrhage rarely fails. The effusion of blood into the membranes of the ovum is an efficient cause of abortion; but probably other factors concur.

Obstinate vomiting not seldom leads to abortion, if much prolonged so as to entail serious blood-poisoning. This is induced by the denial of nutriment from without, so that not only is the ordinary refuse matter of nutrition retained, but the system, feeding upon itself, absorbs its own degraded tissues; the morbidly exalted irritability of the nervous centres easily responds to eccentric irritation, and abortion results, generally, in our experience, too late to save the patient. When she aborts, she is moribund.

The association of abortion with *albuminuria* is well established. The history of albuminuria in pregnancy has been already traced. It is enough in this connection to observe that three factors concur in bringing about abortion. 1. The hemorrhagic character of the blood is increased, favoring extravasation into the membranes of the ovum. 2. The retained and accumulating refuse of the processes of nutrition in the fœtal and maternal circulation may empoison and kill the embryo. 3. This refuse poison acting upon the exalted diastaltic centre and upon the uterine fibre provokes uterine contractions. Carbonic acid certainly accumulates in undue proportion during the comatose stage, and this is an efficient cause of abortion.

In the asphyxia, or cyanosis, at first slow and intermittent, then advancing rapidly and becoming intense, of some forms of heart and lung disease, the accumulating carbonic acid is probably the most active factor in causing the abortion so frequently observed. This result may be explained by the action of this poison upon the uterine fibre which Marshall Hall and Brown-Séquard insisted upon, or through the direct irritation of the diastaltic centre, and partly through the extravasating property acquired by the blood.

The efficiency of carbonic acid in the blood in provoking abortion is most clearly demonstrated in the asphyxia of the *moribund*. Thus, in coma from cerebral apoplexy, I have seen abortion take place with hemorrhage in the agony of death, when the presumption was strong that no other cause was at work.

Closely related to the foregoing examples of autogenetic poisoning are the blood conditions associated with *anæmia*, ordinary and pernicious; of *overlactation* with *obstinate vomiting*, with *true Bright's disease* (as distinguished from the simple albuminuria of pregnancy), with *lithiasis* and *jaundice*. In anæmia there is infallibly defective elimination of refuse matter; the attachments of the ovum to the uterus are badly maintained, nutrition being imperfect; the bloodvessels easily permit of watery effusion, which still further impair the utero-ovular attachments, and the nervous irritability being exalted, abortion is easily provoked.

Oversuckling.—When a suckling woman conceives, the probability of abortion is great.

The factors are: (1) the blood degradation, or anæmia and its attendant empoisonment; (2) the malnutrition of the embryo and its uterine attachments; (3) the tendency to blood and serous exudations; (4) the double eccentric irritation of the diastaltic function proceeding from the uterus and the breast. To this last factor Tyler Smith attributed the main influence. We believe that the first three enter largely into the process. It may be stated broadly that few women can bear the task of supporting three organisms. One must be abandoned, and nature mostly throws off the least important, the embryo. Often she is aided in this conservative work by the ovaries, which, resuming functional activity, determine blood to the uterus, leading to extravasation and increasing the activity of the diastaltic function.

Anæmia is a very wide term, and includes, perhaps, conditions of blood that essentially differ. It is often attended by abortion. It may be conjectured that the maternal blood, without carrying any positively poisonous ingredient to the child, may destroy by its negative qualities, by its lacking the proper nutritive and depurating capacity.

Lithiasis has in several cases been the only condition to which an abortion could be referred. It probably is an indication of defective action of the liver and kidneys, and of consequent retention in the blood of refuse matter.

II. Diseases Disturbing the Circulation Dynamically.

Liver diseases, which impede the return of blood by the portal system; heart diseases, especially regurgitant disease and hypertrophy; and lung disease, with severe dyspnœa, are apt to cause abortion. These conditions are rarely simple; alterations in the blood soon become added to the mechanical difficulty in the circulation.

Excessive vascular tension is a form of dynamic disturbance which may lead to abortion. This, when not much exceeding the normal condition of pregnancy, is met by the accommodating capacity of the system; but if it be much in excess, or be increased suddenly, abortion is very likely to ensue. Here we see an illustration of the conservative operation of abortion. The ovum thrown off, the dangerous excess of vascular tension is instantly reduced.

Thoracic and abdominal tumors may act by compressing the organs of circulation.

III. Causes Acting Through the Nervous System.

Strictly speaking, all causes involve nervous action; but here we mean those causes which act primarily or specially through nervous disturbance. We believe the influence commonly attributed to nervous impressions, as emotions, shock, and reflex or diastaltic excitation, is exaggerated. The healthy ovum clings to the healthy uterus with wonderful tenacity. Unless the utero-ovuline attachments be impaired, the strongest emotions may be undergone with impunity. Shock all but fatal, fatal even, has been sustained without provoking abortion. Limbs have been amputated, ovarian tumors have been removed, without disturbing gestation. The explanation seems to be that where nervous impressions act, there is something defective in the gestation. Under extreme anæmia for example, the embryo may be badly nourished, the utero-placental attachments tending to degeneration. In such a condition a strong nervous shock, especially if occurring at a menstrual epoch, may suddenly determine an unusual blood-flow to the uterus, and under the hydraulic strain blood is effused into the ovular membranes, and abortion ensues. The extravasation is mechanical. If by hypothesis we substitute the pumping force of the syringe for that of the heart, we might liken the extravasation that takes place under shock or emotion in the living to the extravasation produced by forcible injection of the uterine arteries after death.

That reflex excitation simply is not very efficient is proved by the frequent failure of irritation applied to the cervix uteri to produce abortion. Irritation applied higher up to the fundus uteri almost necessarily involves disruption of the attachments of the ovum as well.

Convulsion, as from vomiting, epilepsy, eclampsia, acts indirectly; partly by derivation of nerve-force from its proper destination, partly by associated blood disorder, partly in some cases by the consequent killing of the embryo, partly by the attendant asphyxia, and partly by concussion or strain telling mechanically upon the uterus. Apoplexy can hardly be said to produce abortion directly by the convulsion. It is, we believe, almost always through the induced asphyxia.

Severe and repeated coughing, especially whooping-cough, may produce abortion by succussion and disturbance of the ovum. This is more likely to tell near the end of gestation. We have several times known coughing to precipitate labor.

IV. Local or Pelvic Diseases.

Disease of the uterus is a frequent cause. Whitehead and Bennet insist much and rightly upon the influence of inflammation and congestion of the cervix in promoting abortion. Whitehead traced to disease of the lower part of the uterus 275 abortions out of 378. Although the cervix does not enter directly into relation with the ovum, it is so far in solidarity with the body of the uterus that excessive hyperæmia of the cervix, with the attendant morbid processes, can hardly fail to entail undue afflux of blood and nervous disturbance in the body of the uterus. Hence the risks of extravasation into the membranes, and abortion. Moreover, a long-standing endometritis will be likely to produce an unhealthy decidua, so that at an early stage of gestation it breaks down, and thus arises another cause of abortion. Frequently, indeed, gestation is prevented by endometritis; but if partially cured, gestation may take place, proceed a little way, and end in abortion.

Placenta prævia, a form of ectopic gestation in which the ovum grows in ıe lower zone of the uterine cavity, a site not adapted for full development, ften ends in abortion.

Mechanical anomalies of the uterus, as flexions and versions, are frequent auses of abortion. The history of these anomalies will be traced elsewhere.

Tumors in the walls of the uterus and extrauterine tumors, especially the ›rmer, readily cause abortion. These complications have been described in he chapter on "Diseases of Gestation."

Fissures of the cervix uteri, the result of injury sustained in labor, may, ccording to Whitehead and Emmet, lead to abortion.

Adhesions of the uterus, the result of peritonitis, may cause abortion by mpeding the due growth and evolution of the uterus.

V. Adolescent and Climacteric Abortions.

The two extremes of the reproductive epoch are often signalized by abortion. Impregnation may take place before the uterus is developed enough to carry through the gestation. Its capacity for keeping pace with the rapidly growing ovum being outrun, abortion ensues. Added to this incapacity of immaturity other conditions may concur. The fact is undoubted that very early pregnancies give a large proportion of abortions. Whitehead says that in Manchester, marriage before pubescence is frequent, and abortions result. Probably sexual excesses enter as a factor. Serres found abortion at four or five weeks very frequent in young prostitutes.

During the period of sexual decline, abortion is very common. The last effort of the generative system seems to be to produce a child. Advancing atrophic involution cuts short the gestation. Ovulation or the maturation of ova begins before, and persists for a time beyond, the capacity of the uterus to adapt itself to the development of the embryo. Towards the climacteric the muscular structure of the uterus begins to degenerate. A process of atrophy sets in. The mucous membrane, too, undergoes a change which unfits it for development into decidua. This, added to a disposition to menorrhagia depending upon torpid hepatic circulation, determines abortion at about two or three months of gestation or earlier. A frequent factor of abortion at each extreme of life, especially at the climacteric, is the marked disposition to hemorrhage.

VI. Abortions Artificially Caused by Violence.

Blows or severe pressure upon the abdomen, may cause disruption of the utero-placental attachments, and thus entail abortion. We have known several instances of women subjected to squeezing in crowds aborting. In such cases metritis and perimetritis are likely to follow; in some cases even rupture of the uterus has been thus produced.

Then there are *injuries inflicted directly upon the ovum*, mostly with the intent to procure abortion. These are generally in the form of punctures or tearings of the ovum by means of instruments passed into the uterus.

Tardieu[1] enumerates the following as amongst the means resorted to:

1. Indirect Means.—Bleeding: but this is generally of no effect; baths; forced exertions. Medicines: he denies the efficacy of squills, sarsaparilla, guaiacum, aloes, camomile, matricaria, saffron, borax, juniper, iodine, savin, rue, ergot, taxus baccata.

[1] Étude médico-légale sur l'avortement.

2. DIRECT METHODS.—The use of stilets, injections. Tardieu cites a large number of deaths following criminal abortion.

Surgical Operations.—In this place it is convenient to give a summary view of the relation of surgical operations to gravidity. This subject has been discussed by Robert Barnes[1] and Cohnstein.[2]

Venesection and tooth-drawing do not entail serious risk of abortion or other evil. Cohnstein collects eleven cases of herniotomy, the patients being from three to six months pregnant. In 3 abortion followed soon after the operation; in 1 of these death ensued by peritonitis; in 7 the gravidity went on to term, living children being brought forth. Crural hernia was the most frequent form. Healing was quick. Considering that the operation was resorted to after procrastination and repeated taxis, it can hardly be said that the gravidity made much difference in the result.

Penetrating wounds of the abdomen, from falling on a pitchfork, from a scythe, or by goring by a bull's horn, have generally caused abortion, even when the uterus escaped injury. (In one classical case Cæsarean section was performed by a bull.) Healing of the wound has been quick.

Tracheotomy has been done in 6 cases. In 3, death ensued within forty-eight hours—that is, the operation failed to save. In 2, abortion quickly followed. It is probable that the defective oxygenation of the blood due to the disease which called for the operation was a material factor in causing the abortion.

It does not appear that the bones are more liable to fracture than in the non-gravid state; the healing is as good. Even complicated fractures have not induced abortion. There is a history of a woman falling from a great height to escape from a house on fire without aborting. Four cases of amputation of limbs[3] are recorded; in 2 abortion occurred; 1 woman died of septicæmia.

Operations, even upon the genital organs, may be performed with safety. Œdema of the vulva may be drained by Southey's tube. The labia, hypertrophied by cancer or condyloma, may be amputated. Robert Barnes has thus removed an enormous mass of condylomata, the patient doing well. Polypus uteri, if projecting into the vagina, may be removed. This is best done by the wire-écraseur.

Ulceration, so called, of the cervix uteri has been repeatedly treated by caustics without inducing abortion. We must, however, affirm that such treatment is very rarely called for. The intense hyperæmia and epithelium-shedding characteristic of gestation have been mistaken for inflammation and ulceration, and even for epithelioma.

Amputation of the cervix uteri, or at least of the vaginal portion, for epithelioma, has been practised several times, by ourselves amongst others, without entailing abortion or other mishap.

The breast has also been amputated for cancer successfully. Tapping for ascites may be done without special danger. The comparative safety of ovariotomy has been noted.

Griesinger says that operations on pregnant women suffering from diabetes may be fatal.

In discussing the question of operating we must be governed by the nature and urgency of the surgical indication. If this is clear, the complication of gestation may be practically disregarded. We cannot be justified in letting a woman drift into peril from advancing disease, refusing her the resources

[1] Lane's ed. of Cooper's Surg. Dictionary.
[2] Volkmann's Klinisch. Vorträge, 1870–75.
[3] See Napper, Obst. Trans., 1866, for one.

of surgery because she is pregnant. If at any time there might have been a dispute upon this point, the advances in surgery, aided by Listerism, are enough to solve all doubt.

Reparative processes seem even to be promoted by the conditions of pregnancy. The risk of septicæmia is even less. A cognate question is as to the action of chloroform. Does chloroform, or ether-narcosis, dispose to abortion? We are inclined to think it does. But even this consideration cannot outweigh that of the indication for surgical treatment.

Epidemic or endemic abortion has been described. In certain seasons and in certain districts it has been observed that abortion was so common as to suggest the presence of an epidemic influence. Are abortions more prevalent during epidemics of fever amongst women who do not manifest the usual characters of the disease? It is not improbable that the zymotic poison may be taken up by the pregnant woman, and provoke abortion either by first killing the embryo, or by exciting uterine action.

In times of great political agitation, terror may cause abortion in many women simultaneously; but there is reason to conjecture that physical meteorological agencies may have similar influences. Although the fœtus does not breathe directly, it breathes through its mother. It is, therefore, subject to the influence of the air which the mother breathes. If the south wind prevails in the winter, if the season is rainy and the spring cold, pregnant women are liable to abort; and if they go their time, the children are languid and weak.[1]

Sympathetic abortion has relations to the preceding conditions. Pregnant women, in proportion as they approach their time, at the sight of other women in labor often experience uterine contractions. A similar phenomenon is observed amongst cows. A doctor in the family way should not attend a woman in labor; awkward complications might arise.

The Process of Abortion.

In a large proportion of the cases of abortion occurring under the above influences, not only very marked congestion, but extravasations in various forms are found in the placenta and membranes. The abortion is brought about in one of two ways. The embryo may or may not be destroyed prior to the expulsion of the ovum. The process of extrusion may be slow and gradual or abrupt. But the chief distinction that pathological observation leads us to make, is that between abortions following upon simple congestion, and abortions from congestion complicated with extravasation. In the first class the process is as follows: in those conditions of the maternal system which bring about a gradual deterioration of the mother's blood, the placental congestion is of a passive character; the nutritive and eliminative changes required by the fœtus are consequently imperfectly carried on; but it is only gradually that the embryo suffers, and its death may be long postponed. In abortions of this class the death of the fœtus is the *first* step. The *second* consists in the death of the placenta, which for the most part, but not always, soon follows upon the withdrawal of the attractive force which the life processes of the embryo supply. The fœtal portion always dies, and quickly, as necessarily as does the lung of the air-breathing animal. It is the maternal portion that may, and sometimes does, live on for an indefinite period. But whether the whole placenta die immediately after the death of the embryo, or whether the maternal portion retain for a time its vascular con-

[1] Clinique des hôpitaux des enfants, 1842.

nection with the uterus, the probability is great that the embryo will soon be expelled from the uterus. It often happens, especially in the case of abortion after the fourth month, that the embryo is expelled before the placenta and membranes, these last retaining a more or less intimate relation to the uterus for some time longer. But in abortions at an earlier period, and especially as we approach the third or second month of gestation, the ovum more usually comes away in a mass. But for this to happen, a *third* stage must be completed; the death of the fœtal and maternal placenta and envelopes taking place retrogressively, the vascular connections between the uterus and placenta are cut off; the uterus itself, no longer stimulated to active growth, falls back towards the unimpregnated condition—that is, it undergoes a process of involution, its blood supply diminishes, and its muscular structure, first feeling the want of nutritive elements, and then undergoing fatty metamorphosis, the uterus rapidly contracts in all its dimensions. But simultaneously with the involution of the muscular structure of the uterus, the decidua is undergoing a similar process. The end of the involution of the uterine mucous membrane is exfoliation or detachment. The minute observation of a considerable number of aborted ova, in cases where the abortion followed upon death of the embryo, has satisfied us that this gradual detachment of the mucous membrane is effected by a fatty metamorphosis of its elements. This detachment effected, the ovum lies loose in the cavity of the uterus, and is in all respects a foreign body. When the contraction of the uterus attending its advancing involution has attained a certain point, the dead ovum is pressed upon by the walls of the lessening cavity. The contraction, which up to this moment had been mainly atrophic and passive, is now replaced by active muscular contraction, the result of reflex or diastaltic excitation. Under this spasmodic action, the *fourth* stage of abortion, the expulsion of the ovum is effected. But sometimes the stimulus to expulsive uterine contraction is of a different kind; the diastaltic arc does not begin and end in the uterus itself. The ovaries resume their sway, and the next menstrual or ovulation nisus will stimulate the uterus to contract, the menstrual blood effusion precipitating the detachment.

The separation may thus be forcible. What violence sometimes attends this separation of the maternal element of the placenta may be judged of from a fact we have often observed; the uterus, contracting with spasmodic fury, not only casts off its mucous membrane, but numerous muscular fibres are torn off with it. These may be seen, by the microscope, attached to the decidua on the external surface of the expelled ovum.

Such is the course of the abortive process, as it usually takes place when the death of the fœtus, ensuing upon passive congestion or slow asphyxia, constitutes the first step. But abortion frequently happens much more suddenly. Under the influence of any of the causes producing congestion, it may be that, owing to a peculiar hemorrhagic condition of the blood, the exaggerated force with which the congestion acts, or more frequently, to the intercurrence of some powerful exciting cause, active congestion of the uterus, of course extending to the decidua or maternal placenta, is induced. This is quickly followed by extravasation into the placental parenchyma. Should the extravasation be extensive, so as to disable *suddenly* a large portion of the placenta, the fœtus is destroyed immediately, and in all probability the commotion set up in the uterus goes on to excite active contraction, so that the forcible separation and extrusion of the ovum are effected. Sometimes, however, although the extravasation is extensive, the embryo is not so immediately killed, but that the complete detachment and expulsion of the ovum precede, the embryo being born alive. In such cases it com-

monly happens that the ovum is burst by the violent compression of the uterus, and the embryo is expelled before the membranes.

Theoretically and actually the causes of abortion are *predisposing and exciting*. It is of clinical importance to recognize this. It is true that emotion, shock, coitus, ovarian, mammary, alimentary irritation may seem to be causes of abortion; but abortion induced purely in this manner is of very rare occurrence. The healthy uterus, containing a healthy ovum, is not at the mercy of every emotional or diastaltic accident. To admit the affirmative would be an impeachment against the conservative provisions of Nature. The action of these influences presupposes conditions favoring abortion. Diastaltic action, in fine, is the mechanical force which completes the abortion, not its primary cause.

The most Common Period of Abortion.—The greater number of abortions probably take place at the second and third months of gestation—that is, before the fœtal and maternal elements of the placenta have fairly amalgamated. It is probable also that a number of ova perish at an early period from original defect of vitality.

The Symptoms and Diagnosis of Abortion.—The two main symptoms are *hemorrhage* and *pain*. In most cases hemorrhage is preceded by thin mucous or watery discharges, pain at first not being felt. This may go on for two, three, or more days, when gradually or suddenly blood is observed. If the blood be copious, and especially if it come in clots, pain usually sets in. When these two signs concur, abortion is imminent. The pain is likened to colic at first in the hypogastrium; later it is likened to labor-pains. The colic indicates distention of the uterus by blood; the labor-pains the contraction of the uterus to expel its contents. But it must be remembered that neither pain nor hemorrhage is necessary to abortion.

To *diagnose abortion in progress* we must first prove pregnancy. To distinguish abortion from dysmenorrhœa and menorrhagia we rely upon a history of—(1) one or more missed menstruations; (2) a uterus uniformly enlarged to correspond with the time elapsed since the last menstruation, and the other objective signs of early pregnancy; (3) we seek to exclude other conditions which may account for the suspension of menstruation and the uterine enlargement.

The conditions found on examination are significant: the *vagina is relaxed, lubricated with mucus; the uterus is lowered in the pelvic cavity;* and if contractions have set in, there is a characteristic *dilatation of the vaginal roof*, forming a true cavity, the walls being held apart. This is due to the contraction of the muscular fibres in the broad and round ligaments which pull the vaginal roof upwards and outwards, whilst the body of the uterus is driven down into it. This condition was described by E. Martin. In conjunction with copious hemorrhage and pain it is almost pathognomonic of abortion. It may to some extent be simulated during the expulsion of a polypus; but mostly the presence of adjunctive symptoms will establish the diagnosis. Then there are observed *softening and dilatation of the os externum and cervix uteri*. And if abortion is advancing, we shall feel a soft quaggy substance presenting in the cervix, which may be clot or a portion of the ovum.

To *diagnose an accomplished abortion* we examine the substances expelled from the vagina. If we detect chorion-villi, the evidence is conclusive. Wanting this, a discreet reserve is the wisest policy. We may generally conclude that the abortion is not completed—that is, that something is still retained *in utero* if hemorrhage and pain continue.

According to the age of the conception and other circumstances, the ovum comes away in different forms. In abortions, at from six to eight weeks, the

embryo is often expelled enveloped in its amnion and chorion. The shaggy white villi are seen covering a small bladder which contains a clear fluid—the liquor amnii and the embryo. The decidua may remain attached for some time longer. In abortions at three or four months, the embryo is sometimes expelled first alone, the ovum having burst *in utero*. Then the amnion, chorion, decidua, and placenta are cast out together. But the whole ovum may come away *en masse*. This is more likely to happen when the embryo has perished some time before expulsion, and when the process of retrogression of the connecting media between uterus and placenta has made some progress. The diseased ova are the most likely to be thrown off in this entire form.

In every case it is important to examine what comes away, to judge whether any part yet remains unaccounted for.

TREATMENT.—Rest in bed must be enforced. The first point to consider is: Can the threatening abortion be averted? Can the gestation continue? All hope of this may be given up if we find any portion of the ovum in the discharges, or if hemorrhage and pain continue, and the cervix be dilating. Under these conditions, the sooner the uterus is emptied the better. But this does not always imply that it is necessary or wise to empty the uterus precipitately. So long as the hemorrhage is moderate in amount, it may be wise to temporize, giving time for the natural forces to loosen the attachments of the ovum to the uterus. The pain and hemorrhage may be moderated by digitalis, hamamelis, and opium; and if it be considered desirable to promote active contraction of the uterus, ergot may be given. Watching the patient, we estimate the impression made upon her system by the losses. If we find hemorrhage continue, the pulse rising in frequency, falling in strength, tendency to syncope, we may conclude that expectancy is no longer safe, and we proceed to empty the uterus.

How to Empty the Uterus?—If the cervix be well expanded so as to admit one or two fingers, the patient is rendered insensible by ether or chloroform. Lying on her left side in obstetric posture, one or two fingers of the left hand are passed into the uterus, whilst the fundus uteri is pressed firmly down upon the exploring fingers. In this way the cavity of the uterus is explored and the ovum is detached. Great care is necessary in this operation; it is often very difficult; and without anæsthesia most painful. Not seldom it is necessary to pass the entire hand into the vagina. It requires firmness, gentleness, and patience.

Levret and others used ovum forceps and scoops to bring away the ovum; and from time to time instruments of this description are reinvented for this purpose. Without absolutely condemning them, we may say that experience has taught us to abandon them. No instrument can vie with the sentient finger, which, whilst carrying out the operation, gives information of its progress and tells us when it is completed.

Care should be taken to insure relief of the bowels. A copious enema of soap and water with a tablespoonful of turpentine proves of great value.

Then there is another case. Hemorrhage, and the general condition of the patient, indicate that it is expedient to deliver, and yet the undilated cervix will not permit the operation to be carried out. What is to be done? The vagina may be plugged with pledgets of lint or sponge, squeezed out of weak carbolic water, 1 in 50, a string being attached to each to facilitate removal. In this way a twofold object is accomplished. The hemorrhage is retarded, if not stopped, and the dilatation of the cervix is promoted by diastaltic excitation. Commonly in a few hours the plugs get so compressed and hardened by infiltration of blood, that they cease to fill the vagina, and blood may flow past. But the plugs should rarely be left more than eight

hours. Fresh ones may be introduced if required. Whilst in use, it is necessary to ascertain if the bladder is relieved. The catheter may be required.

Should plugging the vagina fail, or the urgency of the case indicate more certain proceedings, the cervix itself should be dilated. One or more laminaria or sponge-tents may be introduced into the cervix, and kept from slipping out by a vaginal plug. This will always command sufficient dilatation within six or eight hours, and in the meantime hemorrhage is controlled.

Should hemorrhage persist after the emptying of the uterus, and the subject be considered to be in danger, ergot, acids, opium, turpentine, may be tried; but if obstinate, we have recourse to topical treatment. First, we may insert a piece of ice in the uterus; this failing, we may inject gently a stream of hot water (110° F.) into the uterus; then a stream of cold water; then a solution of tincture of iodine, 1 in 10, tepid; and if this fail, the case is one for stronger styptics, of which the most efficient is the ferric chloride. This should be applied by swabbing the interior of the uterus with a probang, armed with sponge soaked in the solution, 1 in 10.

It is very rare for fatal hemorrhage to attend abortion, but drainage may be so severe as to expose the patient to other dangers.

The *after-history of abortion* is similar to that of labor at term.

1. *The Physiological Phenomena.*—When completed, the hemorrhagic discharge gradually lessens; it becomes more watery, then mucous; merging into leucorrhœa. The uterus contracts, undergoes involution, and the return to the ordinary state of non-pregnancy is completed within a month. Not seldom a menstrual flow will set in a month after the abortion, but sometimes a period may be missed.

2. *Pathological.*—The subject is liable to the diseases of low nervous and vascular tension.

After-treatment.—Even in so-called "slight miscarriages," rest in bed for a week at least is wise. The patient is liable to all the ills that may attend labor at term. Locally, there is the risk of metritis, perimetritis, thrombosis, and retroversion of the uterus if the patient get up too soon. Constitutionally, septicæmia may arise.

To obviate these accidents, the diet should be moderate; generally stimulants should be avoided; ergot, quinine, digitalis, opium, are useful for the first week. The vagina should be syringed out daily with carbolized water, 1 in 50. If the discharge is offensive, the physician himself should syringe out the uterus.

In the event of septicæmia, the uterus should be explored to make sure that there is no part of ovum, clot, or offensive matter there.

The restorative treatment is conducted on ordinary principles. The recovery from the abortion effected, *prophylactic treatment* comes into consideration. The causes which led to the abortion may persist or return. We must trace back, if possible, the history of the patient, and subject her to such treatment as may be indicated. One rule we hold to be of great practical importance; if the patient has been known to suffer from retroversion or prolapsus of the uterus, a suitable Hodge pessary should be adjusted on her resuming the upright posture, and worn for two or three months, or until the pelvic structures and the system at large have recovered due tone.

CHAPTER XIII.

DISEASES OF THE EMBRYO.[1]

EVIDENCE is not wanting to prove that the embryo may be diseased, deformed, and perish through inherent fault derived from the father, the mother remaining healthy. In this way the embryo itself must be regarded as the proximate cause of abortion. Heredity from the paternal side, then, accounts for some abortions. It has been stated in an earlier part of this work that we must regard the ovum from the moment of impregnation as a distinct animal, possessing an individuality of its own; that it finds in the uterus a nidus where it may go through the earlier or incubative stages of its growth; and that in this position, although dependent upon the mother for the materials of nutrition and for the means of excretion, it is not strictly a part of the mother, but a new organism grafted upon her. It is strictly a parasite.

In searching out the diseases of the embryo, we are necessarily led to examine the placenta. This organ, in fact, holds a part of the embryo. We shall, therefore, follow up the study of the conditions of the body of the embryo by tracing the abnormal conditions of the fœtal element of the placenta. On the other hand, we shall have to trace the morbid conditions of the mother, structural and humoral, into the maternal element of the placenta. Thus, taking up the diseases of the fœtal and maternal elements, first separately, we shall then endeavor to trace them to their point of junction, and to examine their mutual reactions. The study is beset with difficulties; we are compelled to have recourse to *à priori* reasoning, sometimes to conjecture, but it will amply repay investigation. In this study we may perhaps, discover the germs of the pathology of the child and the adult; we ascend more nearly to the origin of diathesis, the great problem in pathology, the one most momentous in its influence upon the human race.

CLASSIFICATION OF THE FŒTAL CAUSES OF ABORTION.

A. *Diseases of embryo generally causing its premature death.*
- Faults of development; some monstrosities.
- Diseases of nervous system.
- Diseases of kidney, liver.
- Diseases, general, as syphilis.
- Mechanical, or anything causing death of embryo, as torsion of the cord, strangulation of the cord, pressure from a twin fœtus.
- Inflammation of serous membranes; peritonitis, pericarditis, pleuritis.
- Sclerema, ichthyosis, goître, or bronchocele.

B. *Diseases of the ovum, membranes, and placenta.*
- The membranes of placenta are compounded of *fœtal elements* and *maternal elements.*
- Hence, there are *diseases of the fœtal element* mostly derived from the fœtus and the father, and *diseases of the maternal element* mostly derived from the mother.

[1] The student is advised to turn back to the chapter on the "Physiology of the Embryo." Thus prepared, he will enter upon the study of the diseases of the embryo with greater intelligence and profit.

1. Diseases of the *fœtal element*, *i. e.*, of the amnion and chorion; congestion and inflammation.
   Dropsy, hypertrophy, atrophy cystic, or hydatidiform degeneration, fatty degeneration, calcareous degeneration.

2. Diseases of *maternal element of placenta*.
   Disease of decidua, not yet formed into placenta, inflammatory, syphilitic, strumous.
   Disease of decidua when forming part of structure of placenta; congestion, inflammation, abscess, apoplexy or hæmatoma, "fleshy mole," fibrinous effusions, induration, hypertrophy, atrophy, fatty, calcareous, and fibrous degenerations.
   Distinction between fatty degeneration and fatty metamorphosis; fatty degeneration attacks living tissues, and is of pathological significance; fatty metamorphosis is a change in dead tissue.
   Fleshy, fibrinous, fibrous tissue moles, distinguished from placental or true ovular moles.

The following sketch of the pathology of the embryo is not limited to the description of those conditions or cases which lead to abortion. Such a limitation would present but a very partial view of the subject. It is therefore more convenient and instructive to sketch in one continuous history the malformations and diseases of the embryo and fœtus, whether resulting in abortion or not. In one sense, indeed, many even of the subjects of intra-uterine disease and malformation which survive birth may be said to be abortions. They are more or less unfitted for life, and are frequently foredoomed to early death.

Malformations.—In early times even down to the eighteenth century, malformations gave unbounded scope to the fancy. Heads of dogs, cats, pigs have been depicted set upon human bodies; the "*mulier formosa superne quæ desinit in piscem*" has even been exhibited in our day. But these creations of the imagination have vanished from scientific discussion, and their place is taken by well-observed facts. The study of development now supplies the basis for a scientific understanding of the genesis of the various forms.

The scope of this work makes it impossible to give even a sketch of the infinite aberrations met with. We refer to the admirable works of Förster[1] and of Ahlfeld,[2] in which they are systematically described and figured. We must be content with describing the more common varieties which offer special clinical interest, either in their bearing upon labor or as regards the immediate treatment of the new-born subjects. Those aberrations of form which give rise to dystocia will be referred to in that connection.

Definition.—Comprehensively, malformations are defined as *vitia primæ conformationis*, including every aberration of form due to disturbance in the first stages of the evolution of the embryo. Usage has assigned various designations to the degrees of deformity. Thus, a malformation affecting a large part, and assuming an ugly or revolting appearance, is called a *monster*, or "*teras*" (from τέρας, a sign, portent, or huge unearthly monster); if the body generally is well shaped, and only small parts are malformed, it is called a *lusus naturæ*, anomaly, or deformation, and slighter degrees are called *varieties*.

Many *classifications* have been propounded. Geoffrey St. Hilaire's is the basis of most.

We quote the following passage from Simpson: "The happy idea that was first suggested by the master mind of Harvey, relative to certain mal-

[1] Missbildungen der Menschen, 1861.
[2] Die Missbildungen der Menschen, mit Atlas, 1880-82.

formations consisting, *not* in the *substitution* of an entirely new and anomalous type of structure in the malformed part, but only in the simple *permanence* of some of its transitory fœtal types, has been reduced within the last thirty years (before 1839) by the able investigations of Wolff, Autenrieth, Meckel, St. Hilaire, and others into one of the most certain and comprehensive, and at the same time one of the most beautiful, laws in teratological anatomy."

Ahlfeld discusses the several theories of the genesis of malformations. In the first place, he ranks the cases of *splitting of the not-yet differentiated germ*. These are the *double formations*. First of these is *entire splitting of the germ*. These are: 1. Homologous twins; 2. Omphalopagus (union of twins at the umbilicus); 3. Thoracopagus (union at the chest); 4. *Craniopagus*, with its varieties; 5. *Sacralteratom;* 6. *Inclusions:* i. abdominalis (double inclusions), i. testiculi, i. ovarii, i. subcutanea, i. of the mediastinum, i. of the lungs, i. of the cranial cavity.

Fœtal transplantations.

Partial splitting of the germ.

Multiple splitting of the germ.

Homologous triplets.

Tricephalus.

Splitting of Single Organs, or Duplication.—Doubling of the extremities, of the hands, feet, fingers, toes; splitting of the finger-nail, splitting of the mammary gland, or polymastia; doubling of the nipple; multiplication of the vertebræ (formation of a tail, tail-like outgrowths); multiplication of the ribs, cervical.

Giant Formations.

Gigantic Growth.—Excessive development of one entire half of the body; excessive development of the whole heart; strong development of one-half of the head; one-sided enlargement of one limb; gigantic growth of hands and feet; trophy of the external ear, of the cheeks; macroglossia; gigantic growth of a tooth; struma congenita; hypertrophy of breast, heart, kidneys, bladder, uterus, clitoris, penis.

Splittings of the Anterior Union Line.—These will be noticed hereafter.

Splittings of the Posterior Union Line.—Watery collections in the course of the cerebro-spinal canal; hydrocephalus; defective ossification of the cranial vault; intercalated bones; cerebral hernia; encephalocele and hydrencephalocele, occipital and frontal; cerebral hernia of the base; microcephalus; parencephalus; cyclopus; hemicephalus; hemicrania; craniochisis; spina bifida; cysts of the sacrum.

We will now point out more especially the principal deformities which it is important to recognize clinically with a view to surgical treatment. For the following summary we are chiefly indebted to Mr. Noble Smith, whose studies and experience in this relation give him an authority to which we cannot pretend.

DEFORMITIES FROM ARREST OF DEVELOPMENT.

1. Non-closure of the anterior part of the body (the visceral arches), more or less extensive.

(*a*) In which the whole anterior part of the body is fissured, leaving the thoracic and abdominal viscera exposed, and often, also, displaced.

(*b*) Fissure of the thorax alone.

(*c*) Fissure of the abdomen alone.

(*d*) Fissure of the pubic and hypogastric region.

There may be only a fissured sternum, or deficiency of its lower end, or deficiency of muscular structure.

2. Fissure of the face, including cleft-palate, harelip, etc.

3. Fissure of the skull (acrania). Various degrees of deficiencies of the cranium have been grouped with various types.

4. Fissure of the back part of the body from non-closure of dorsal laminæ, producing spina bifida.

5. Hydrocephalus.

6. Acephalus. Fœtus without a head.

7. Want and defective formation of the trunk.

8. Absence or defective formation of the extremities.

9. Cyclopia.

10. Deficiency of lower jaw.

DEFORMITIES FROM EXCESS OF DEVELOPMENT.

I. Fœtus in Fœtu. Some remarkable examples are known. We have seen a specimen in the Munich Museum of the chest of a man who had served as an officer in the army. Included in it is a nearly developed fœtus.

II. Parasitic monsters.

III. Double monsters.

IV. Additional parts, such as supernumerary arms, legs, fingers, toes, etc.

MONSTROSITIES.

Under this head we include those severe cases of malformation which cannot be benefited by surgical operation, and which are either born dead or die very soon after birth; and also cases of united fœtuses, regarding which the question of surgical interference may arise.

Twin Children United Together.—If the children are in juxtaposition, and the union extensive, a successful separation is impossible. If a band of union exists between them an operation may possibly be practicable. At the *post-mortem* examination of the Siamese twins, Dr. Pancost considered that the closeness of the two livers, and the free anastomoses of the two portal circulations, would have rendered an operation in adult life fatal; but that separation might have been, perhaps, safely effected at the time of birth.

Parasitic Fœtus.—In this monstrosity an imperfectly developed fœtus, or part of a fœtus, is attached more or less extensively to a living child who is otherwise healthy. If there is no insuperable barrier to operation, such as the implication of vital organs, the removal should be effected in early infancy, care being taken that the child is in good health at the time.

DEFORMITIES OF THE HEAD AND NECK.

Hernia of the contents of the skull may exist either as *meningocele*—the protrusion of a sac filled with fluid communicating with the ventricles of the brain—or as *encephalocele*, in which the brain protrudes covered by its membranes, or the sac may contain both brain and fluid.

The cause of these conditions is probably always hydrocephalus; their situation is generally in some part of the middle line of the skull, extending from the root of the nose to the base of the occipital bone; but the pro-

trusion may take place at any part of the skull where the bones ar
by membrane—at the inner side, or above the orbit, or at the sid
skull, or even at the base; the tumor from the latter situation h
known to protrude out of the mouth.

Diagnosis.—The fact of there being a congenital tumor in one of
sible situations of this deformity is strong presumptive evidence.
of the following symptoms is confirmatory:

1. Transparency.
2. Brain symptoms produced by pressing the tumor.
3. Pulsation, unless due to pulsating cancer of the bone, which,
has never been known to be congenital.
4. Irreducibility by pressure.

But the above symptoms may be absent, and the diagnosis very
Great caution should be observed in forming an opinion.

A sebaceous or encysted tumor can be freely moved over th
Erectile tissue may exist over an encephalocele, and so disguise it.

Treatment.—The tumor should be supported by a gutta-percha s
it enlarges, pressure may be tried, and if the case be one of meni
and increasing so rapidly that it threatens a fatal result, the injectio
Morton's iodoglycerine may be worth trying. A few cases have be
by injection of iodine, but, of course, any operation upon such a tu
most serious and desperate proceeding, and, even if successful at
the child is very likely to succumb, at a later period, to hydrocepha

Deficiencies in the Bones of the Skull.—In consequence of impe
velopment of the bones of the skull, openings may be found in the
These are quite distinct from

Unossified fontanelles.
Hydrocephalus.
Supernumerary cranial bones.

Thickening of sterno-mastoid muscle—probably a hypertrophy-
cured by simple treatment: hot-water bathing and the application
of potassium ointment.

ACEPHALOUS MONSTERS.—One example is carefully described
Dickinson.[1] Like all others of the same character, it was a twin.
no head, heart, lungs, or liver. Drs. Young, Brodie, and A. Coop
as is constant in these cases, both cords attached to the same placent
cords anastomosed. The maintenance of the monster is due to t
impulse of the well-developed twin.

Harelip may occur alone or in combination with fissure of th
The common form is that of a division of the upper lip upon
opposite and joining the centre of the nostril.

VARIETIES:

1. Cleft in the muscular structure only, skin and mucous m
being normal, but the covering stretches, and a gap gradually forn
upper part of the cleft only may be covered in this manner.
2. Double harelip.
3. Double harelip, with loose and projecting intermaxillary bo
number of teeth in the latter bone may vary.
4. Absence of intermaxillary bone, the cleft being in the middle o

OPERATION.—Age at which it should be performed. If the chil
difficulty in sucking, Noble Smith is of opinion that surgical int
may be delayed until the child is about two months old, or unti
good general health; but when bad health results from inability

[1] Med.-Chir. Trans., 1863.

perfectly, no time should be lost in performing an operation. Dubois was decidedly in favor of early operation. *Chloroform* should be given for the operation if we can manage to prevent the blood from running into the trachea; this has hitherto been found a great difficulty.

Fissure of the lower lip occurs very rarely.

Lateral fissure of the mouth.

Lateral fissure of the nose.

The treatment of these deformities presents no great difficulties.

Cleft Palate.—The uvula alone may be cleft, or the fissure may involve more or less of the soft palate. The hard palate may also be ununited in the middle line as far forwards as the alveolar ridge, from which point, if the fissure is continued, it proceeds upon one or other side of the intermaxillary portion of the bones of the upper jaw, or, in the most severe cases, proceeds at both sides of this piece of bone. The cleft is sometimes, though rarely, in the middle line of the palate only, union of the parts having taken place before and behind the deficiency. In the most severe cases the intermaxillary bone is separated from the superior maxilla and attached to the septum nasi. Varieties between these extremes exist.

TREATMENT.—There is often great danger to the child from inability to suck; so the child must be fed artificially. The bottle (containing its mother's milk) must be so arranged that its contents will flow easily into the throat.

Operation chiefly aims at allowing speech to be properly acquired, and should be deferred until the child is between two and three years of age.

Absence of one or other of the bones of the face.

Fissures from non-union of upper maxillary bones.

Supernumerary lower jaw.

Dislocation of jaw.

In these cases there is always some malformation of the bones.

Atresia Oris.—Complete closure of the mouth is a rare deformity, and is sometimes the result of deficient development of the lower jaw.

TREATMENT.—Transverse incision and the use of a mechanical appliance to keep the parts asunder, or other means to prevent reunion.

Microstoma Oris.—Extreme smallness of the mouth is also very rare, and is sometimes associated with deficiencies of neighboring parts.

TREATMENT, if any is necessary, should be by gradual dilatation or operation.

Absence of the nose.

Absence of one or both eyes.

Absence of the eyelids.

Absence or deformed shape of the iris.

Cataract.—The late Mr. Critchett informed us that congenital cataract is not rare.

Absence, deficiency, or misplacement of the ears. Atresia auris.—The auricles may be misshapen in various degrees, or may be rudimentary, or supernumerary auricles may exist in the neck.

TREATMENT.—Misshapen ears may often be improved by means of carefully arranged mechanical means.

In cases of closure of the meatus, if the organ of hearing is supposed to be perfect, an operation may be considered. Supernumerary auricles may be removed. In any of these cases treatment should be resorted to early.

Fissures and fistulæ from non-closure or imperfect closure of the branchial arches. The fistula may open into the trachea, pharynx, or other parts.

TREATMENT.—The injection of corrosive fluids has been practised with not very good and sometimes with dangerous results. The affection does

not imperatively call for surgical interference, but if an operation is
a plastic operation would be the best.

(See also Abnormal conditions which may affect any part of th

DEFORMITIES OF THE BODY.

Closure of the Œsophagus.—This tube may be found obliterated
of its length, and under such circumstances it frequently communic
the trachea; food is either ejected or gruëls symptoms of ch
swallowed, the result is of course fatal, and the chances of doing
by operations are very remote.

Stricture of the Œsophagus and Pyriform Œsophagus.—Congen
ture, although very rare, has been found in the lower part of the
part alone has been dilated, probably as a result of food being d
passing the stricture, but the pouching is also stated to be congeni

Deformities of the Vertebral Column.—There may be supernum
tebræ or vertebræ may be deficient, or a portion of a vertebra may
producing congenital lateral curvature. Two or more of the bon
fused together.

Spina Bifida (*Hydrorachis*).—This deformity may involve the wh
of the spine, or any one part of it. The arches of the vertebræ are
and through the fissure the membranes of the spinal cord protru
sac thus formed is filled with fluid.

Coverings of the Sac.—May consist of normal or corrugated
more commonly the wall is very thin and translucent, or the ski
absent.

Large nerves or the cord may or may not be involved in the tu
The presence or absence of portions of the cord or the cauda equ
ese is a matter of importance, as it should influence our mode of de
the tumor.

Diagnosis.—The tumor is in the middle line and is attached to t
The aperture into the spinal canal can generally be felt. Pressu
makes the fontanelles more tense. There may be paralysis or oth
toms of nerve implication, such as *clubfoot*.

If the fluid is found to contain grape sugar we know that the s
noidean cavity has been opened, but the converse does not show
tumor is not spina bifida. If nothing is done, the majority of cas

Treatment.—If the tumor is small, a hollow truss should be
and the effect of support and gentle pressure tried for a time. Bu
are no indications of a natural cure, the question of operation pres
If symptoms of spinal or cerebral pressure occur, or if the tumor in
size notwithstanding the truss, an operation should be advised. A
can be no doubt that the injection of the iodo-glycerine solution a
Dr. Morton, of Glasgow, is the best and safest means of observati
can be performed. Mr. Noble Smith, who has had considerable e
in the treatment of these cases, had the opportunity of dissecti
which he had operated upon successfully several years before, i
who died from another affection, and he found the opening in t
firmly closed by dense fibrous tissue.

In all cases there is great danger in the operation, and especi
large nerves are in the sac.

False spina bifida may consist of: 1. The sac of a true spina b
neck having been obliterated.

2. A congenital tumor.

3. Included fœtal remains.

False spina bifida must be treated upon general principles. These tumors may be connected with some of the pelvic viscera.

It is not uncommon for hydrocephalus and spina bifida to coexist. They are related in mode of origin.

Sacro-coccygeal tumors have a clinical interest in obstetric practice. They may give rise to confusion in diagnosing the presentation, and may, if large, be the cause of dystocia. They have been described by Ammon,[1] and illustrated by Hutchinson.[2] There is a drawing of a remarkable specimen in St. Thomas's Museum, given in Barnes's "Obstetric Operations," 3d ed.

J. Y. Simpson figured examples.[3] These tumors sometimes resemble tails. Some are varieties of spina bifida. Meckel believed some were examples of the *fœtus in fœtu*. They vary very much as regards structure. Sometimes they consist of masses of fatty substances alone; sometimes they contain bones, rudimentary, or more or less developed; or teeth, being, in fact, dermoid. Portions of intestines have been found protruding into them from the infant's abdomen.

In some cases the tumor has been successfully removed.

Mr. Noble Smith has called our attention to specimen No. 296 in the Museum of the Royal College of Surgeons, in which the child died from ulceration of the tumor. The section shows that the tumor could probably have been removed with success.

Thorax Generally.—May be small from arrested development, lungs and heart being also small and ill-developed.

Hernial protrusions of heart and lungs from imperfect development of walls of thorax, such as the next deformity.

Complete or Partial Absence of the Sternum.

Fissure of the sternum.

Absence of one or more ribs, or incompletely developed ribs.

Forked ribs, fusion of ribs.

Pelvis Generally.—May be misshapen, and sometimes from ankylosis of one sacro-iliac synchondrosis.

Cleft Abdominal Walls.—A similar arrest of development to that of cleft sternum may exist in the muscular structures of the front of the abdomen, which may expose the contents of the abdomen, or the central line of the abdomen may be weak from deficiency of muscular structure.

Hernia.—When hernia occurs as a congenital affection, there is always a tendency to natural cure if the bowel is supported within the cavity of the abdomen. A ring pad should be placed over the weak part of the wall, and the whole abdomen supported.

Fig. 102 shows an example of umbilical hernia, or exomphalos.

Plastic operations have been successful in cases of this kind.

Simpson traces it to peritonitis. In some cases this is probably true. It is more commonly traceable to fault of development. In early embryonic life intestines project into the vitelline duct; and if the abdominal wall does not close in so as to secure the intestines behind it, hernia results. The appearance presented at birth is seen in Fig. 102. In "congenital hernia" (specially so-called) the bowel descends into the tunica vaginalis. It may descend into the scrotum, or may not leave the canal. It has no true peritoneal sac. Congenital inguinal hernia may be encysted, being separated

[1] Angeborene chirurgische Krankheiten.
[2] Illustration of Clinical Surgery.
[3] Med. Times and Gaz., 1859.

from the testis by a septum of the tunica vaginalis. This is the so-called "infantile hernia."

Diaphragmatic hernia may also occur congenitally.

FIG. 102.

EXOMPHALOS, OR HERNIA AT THE UMBILICAL RING. (ROBERT BARNES.)

Hernia of the ovaries is sometimes congenital. They descend along the canal of Nuck and bulge in the groins. The bowel alone may occupy this position.

Various *malformations of the intestines* are found. Simpson said these are generally due to inflammation.

Extroversion of the Bladder.—Deficiency of a part of the anterior abdominal wall and bladder, so that the interior of the bladder is exposed.

Although this condition is not necessarily dangerous to life, the inconvenience and suffering which it causes are very great. Mechanical guards may be fitted temporarily. Plastic operations have been partially successful. Attempts to turn the urine into the rectum have hitherto failed.

The best course in many cases is probably to transplant skin upon the mucous membrane of the bladder, so as to convert it into a non-irritable surface.

Epispadias consists in a deficiency, more or less extensive, of the upper part of the penis, leaving the urethra open in the form of a groove. It is often associated with extroversion of the bladder.

The pelvis may be ununited at the position of the symphysis.

TREATMENT.—By plastic operation an attempt may be made to cover the exposed urethra.

Hypospadias consists in a deficiency more or less extensive of the under part of the penis or of the scrotum. (See "Hermaphroditism.")

In these cases there may be attachment of the penis to the scrotum, so that erection cannot take place naturally.

Operation is demanded when the orifice of the urethra is too small to allow free exit for the urine. When the orifice is so far back that procreation will probably be interfered with, it may be desirable to endeavor to construct a more natural passage.

Although the opening of the urethra may be in the situation of the scrotum, yet the urethra may be continued forwards to the glans, and there have a cæcal termination. In such a case perforation of the glans in the natural position of the meatus should be performed, and the posterior opening closed by a plastic operation.

There may be urinary perineal fistulæ.

Urethra.—1. May be absent, as in cases of extroversion.

2. Occluded, in which case the occlusion may exist in any part of the tube, and may be only membranous or several lines in length.

3. Stricture.

4. There may be more or less deficiency of the upper part (epispadias) or of the lower part (hypospadias).

TREATMENT.—If the tube is occluded an operation must be performed at once.

Imperforate Anus and Rectum.—The occlusion may be incomplete or complete; it may be situated at the anus or in any part of the rectum; it may be simply membranous or very extensive. There may be total deficiency of anus and rectum, or of either part alone.

With any of these conditions there may coexist fecal fistulæ between the gut and the bladder, or urethra, or vagina, or the surface of the body.

TREATMENT.—If there is no escape for the feces, it is self-evident that an operation must be performed without much delay; but if there are no certain indications of the nearness of the gut, it is better to wait, so long as the symptoms are not urgent, with the hope of the accumulation of meconium producing a bulging which will indicate the position of the bowel. When the occlusion is too extensive to allow the gut to be reached from the natural direction, colotomy has to be performed.

In cases of fistulous opening from the gut to other parts, an endeavor must be made to form a natural passage.

It may be mentioned that the sigmoid flexure may curve to the right instead of to the left. There may be two congenital fistulæ.

If the genital organs are situated further back than natural, it is probable that no rectum exists.

Occlusion of the lower part of the small intestine has been known to exist.

Umbilical Fistulæ.—The urachus may remain open, allowing the urine to pass through it, or there may be an opening into the bowel.

TREATMENT.—The application of the actual cautery, ligature, or a plastic operation may be tried, but these cases are very difficult to cure.

Herniæ.—From deficient structure of the abdominal walls various herniæ may occur.

This deformity may be:

umbilical, inguinal — the usual forms.
vaginal, through linea alba, above umbilicus — uncommon forms.

TREATMENT.—Reduction of the hernia and support by a pad and bandage, pressing upon the edges and not plugging up the opening. A natural cure usually takes place.

Inguinal Hernia in Conjunction with Retained Testis.—The hernia being caused by the testis remaining in the inguinal canal. The intestine is often attached to the testis.

Retained Testicle.

TREATMENT.—No attempt should be made to alter the position of the gland unless a truss can be placed between it and the ring. If painful, it may be guarded by a hollow truss, or it may be pushed up the canal and a pad with a plug placed upon the opening. In some cases it is desirable to remove the gland.

Misplaced Testicle.—The gland may be situated in other parts, such as in the perineum.

TREATMENT.—The gland may have to be guarded by a hollow truss or removed by operation.

Hydrocele.

TREATMENT should be commenced early. Evaporating and irritating lotions, such as spirit lotion or acetate of ammonia. The various forms of iodine (Mr. Noble Smith recommends the iodide of potassium ointment) should be tried first for a few weeks.

If such means fail, the tumor should be punctured and the fluid withdrawn, and a truss applied to the inguinal canal.

Dermoid cysts of the testicle and included fœtal remains will be described later on.

These tumors should be removed early in life, as they are apt at any time to grow rapidly.

Phimosis.—The prepuce is more or less contracted and may be a natural length, or unnaturally long. In all cases an operation ought to be performed; but unless the interference with micturition is severe, operation may be deferred until the child is at least several months old and in good health.

Noble Smith recommends that the prepuce should be divided with a pair of spring scissors and the edges neatly stitched together, and that circumcision should only be performed when the prepuce is very long. He states that the deformity may be simulated by attachment of the prepuce to the glans.

Hermaphroditism.

The malformations of the sexual organs which constitute hermaphroditism vary very materially in degree. In the slighter cases no difficulty is experienced in determining the sex to which the child belongs, but in other cases the distinction is very difficult to draw; and as the determination of the sex is a matter of very great importance, we have thought it desirable to summarize the chief points which have to be considered.

FIG. 103.

FEMALE HERMAPHRODITE. (FANCOURT BARNES.)

a. Enlarged clitoris. *b*. Depression simulating orifice of urethra. *c*. Frœnum. *d*. Canal through which urine was voided. *e*. Sulcus between labia majora *f*. Labium majus. *g*. Anus.

1. The female may simulate the male in one or more of the following points:

(*a*) The clitoris being large.

(*b*) The glans being indented in the position of the male meatus urinarius, or the glans actually perforated more or less imperfectly by a canal.

(*c*) The vulva nearly closed by a strong membrane or hymen, and the labia united and resembling the scrotum. This is well illustrated in Fig. 103 from a child born in the British Lying-in Hospital, in the wards of Fancourt Barnes.[1]

(*d*) The ovaries being situated in the labia simulating the testicles.

(*e*) Rounded masses of fat in the labia simulating the testicles.

These cases may be complicated in after life by general masculine development of the rest of the body. Features may become masculine, hair grow upon the face and chest, mammæ remain rudimentary, voice become harsh and deep-toned.

2. The male may simulate the female in one or more of the following points:

(*a*) Extroversion of the urinary bladder mistaken for the vulva.

(*b*) Rudimentary condition of the external genital organs.

(*c*) The adhesion of the inferior surface of the penis to the scrotum by a band of integuments.

(*d*) Hypospadias, or more extensive fissure of the parts beneath the penis, in which the scrotum is divided and a fissure of the perineum exists.

Cases are recorded of **true hermaphrodites** in which some of the sexual organs of both sexes existed in one individual.

Deformities of the Vagina.—Adhesion of the anterior part of the walls. This not uncommon condition is sometimes mistaken for imperforate vagina.

TREATMENT.—The membranous union is to be broken down with the finger or with a blunt instrument, and the edges separated with oiled lint. This should be done as soon after birth as possible.

Imperforate Vagina.—The degree of obliteration differs in different cases. The space between the bladder and rectum should be carefully ascertained before any operation is resorted to.

TREATMENT by operation, as a rule, should be performed in early life.

Atresia vaginæ is fully treated of in Barnes's "Diseases of Women." There may be entire closure of the vagina, coexisting in some cases with absence or imperfect formation of the uterus. The defect is commonly overlooked until the age of nubility.

Hernia of the vagina already referred to.

Tumors.

Transpositions of, and abnormalities of formation, and deficiencies of the thoracic, abdominal, and pelvic viscera may exist.

DEFORMITIES OF THE EXTREMITIES.

Deficiencies.

(*a*) *Absence of one or more of the extremities.*

(*b*) *Absence of the intermediate parts*, the hand being attached to the shoulder or the foot to the hip.

(*c*) *Limbs too short.*

(*d*) *Deficiency of individual bones.*

(*e*) *Fusion of bones to one another.*

[1] Obstet. Soc., 1882.

(*f*) *Limbs truncated.*

1. From arrest of development.
2. From amputation and constriction by the umbilical cord or a membranous band.

(*g*) *Diminished number of fingers and toes.*

These cases are beyond remedy by means of treatment except in the instances of truncated limbs, when artificial hands or feet can be supplied at subsequent periods of life.

Limbs may be grooved, or indented, or otherwise injured by the pressure of the umbilical cord or bands of membrane, a partial result of the constriction which might, if continued, have produced the amputation referred to above.

INTRAUTERINE FRACTURES have been observed. Dr. Richardson, in his Fothergillian prize essay on "Diseases of the Fœtus," collected most of the known cases, amongst others that of Chaussier. There were 112 fractures. The child lived twenty-four hours. The mother had borne four children. Baudelocque related a case which presented 43 fractures. The mother had had no accident during pregnancy. Delivery had been rapid and easy. Some of the fractures were consolidated, some were in process of reunion. Montgomery refers to several cases. One was that of a woman eight months pregnant, who fell from a window twenty-five feet on her face. The hip-joint was dislocated; the uterus was not ruptured. She was delivered the same night of a dead child, which had some of its bones broken. She recovered perfectly. The late Dr. Herbert Barker narrated[1] an interesting case: The subject was in her fourth labor. The first three children were sound. The mother showed no sign of cancerous, tubercular, or syphilitic taint. She had several times fallen on the stairs, once with her entire weight on the abdomen. The father was also healthy. During labor the child's limbs were felt to crepitate on the least movement. There was an entire absence of cranial bones. It cried, but died in ten minutes. The limbs were very deformed, preternaturally short. The long bones were all broken. All the bones forming the base of the skull were duly developed. The bones of the vault scarcely showed traces. The spinal column was well developed. The bones were extremely fragile. The organic matter of the bones amounted to 66.66, as against 33.34 per cent. of inorganic. This corresponds with the proportions observed in rickets.

With regard to the fractures of cranial bones, Montgomery observes: "Instances of injury to the cranial bones before birth have been recorded by Osiander, W. J. Schmidt, Schnuhr, D'Outrepont, and Graetzer; and still more recently, three well-marked cases, in which several fractures were found under bloody tumors, were published by Flügel and Schelling. When these injuries were first observed, they were attributed to violence by Haller, Rosa, and others, the error of which opinion was first perceived by Rœderer and Baudelocque."

These cases present points of great obstetric and medico-legal interest. They prove: 1st, that numerous fractures of the cranial and long bones may occur which cannot be accounted for by injury during or after labor; 2, that, although it is probable that fracture may be caused by injury sustained by the mother during gestation, yet they may occur without such injury; 3, that they may occur as solitary instances in a series of healthy children by the same parents, or at least by the same mother.

The dimpled or puckered appearance frequently found in the limbs of children has been attributed to fractures occurring in early fœtal life.

[1] Brit. Med. Journ., 1857.

Amputation of the Limbs in Utero.—Montgomery, Sir J. Simpson, and others have illustrated this subject in a manner to leave little to desire. Children are born occasionally with one or more limbs defective. Cases of survival, all four limbs being truncated, are not very rare. In some of these cases there is the appearance of a clean cicatrized stump; in others, there is the appearance of small processes suggestive of fingers or of rudiments of the parts of limbs which are wanting. Two hypotheses may be discussed. Either, there was a defect of developmental force resulting in the non-formation or arrested development of the missing parts; or there has been a real amputation. In the latter case, the budding processes are accounted for on the analogy of what happens in the crustacea, which possesses the faculty of reproducing a lost limb. The human embryo at an early stage resembles in other characters the lower animals, and it presumably does so in this.

Amputation undoubtedly takes place. Thus Montgomery relates a case from Mr. Watkinson, who delivered a lady of a child which had the left foot amputated a little above the ankle; the stump was nearly healed, the child was alive. The amputated foot was found in the uterus nearly healed. This foot was much smaller than the one which grew to the other leg. In this and similar cases the amputation was due to gradual strangulation by amniotic bands, the result of inflammation of the amnion. The authors quoted figure amputations in process in this manner. Many of the more striking illustrations are reproduced in Martin's "Atlas."[1]

United or "Webbed" Fingers and Toes.—The operation for these deformities may be deferred until the child is six months or a year old.

Supernumerary limbs are considered under the heading of parasitic fœtus.

Supernumerary digits should be operated upon early if there is no doubt regarding the necessity of operation. Care should be taken not to injure a joint when an additional digit has a joint common with a normal digit; a small piece of the former must be left. In a case of double terminal phalanx of the thumb, giving a cleft hoof-like appearance, Mr. Noble Smith united the two halves, producing a fairly good-looking thumb.

A supernumerary hand may exist, and may be a very useful member, or may require removal.

Hypertrophy of Digits or Limbs.—Treatment by pressure should be commenced early, and if that fails, the question of amputation has to be considered.

Dislocations.

Congenital dislocations have been found in the majority of the joints, and probably may occur in any of them. The hip and the shoulder are the joints chiefly affected. The deformities have been attributed to a variety of causes. There is very frequently some malformation of the ends of the bones forming the joint.

Treatment, if likely to be beneficial, should be commenced early.

Under this heading may be referred to those malformations of the joints in which the ordinary movements of the joint are perverted, the leg bending forward instead of backwards. In these cases the patella is generally imperfectly developed or may be absent.

[1] See Martin's Atlas of Obstetrics and Gynecology. English edition by Fancourt Barnes. 1880.

Deformities from Abnormal Contraction of Muscles.

The most familiar examples of this class of congenital deformities are the various forms of *clubfoot*.

We meet also with—

Clubhand.

Wry-neck.

Contractions of the muscles of the arms and forearms.

Contractions of the muscles of the thighs and legs.

TREATMENT.—Much good may be done by manipulations at the earliest period of life. Subsequently stretching by means of splints, plaster bandages, or instruments, alone or with the help of tenotomy, will complete the cure. For full directions regarding the treatment of these cases, see "The Surgery of Deformities," by Noble Smith.

Paralysis of Muscles.—Various deformities, and especially of the limbs, may occur from this cause.

DEFORMITIES AFFECTING ANY PART OF THE BODY.

Congenital fibro-cystic tumors may occur in any part of the body, but the purely cystic have not been observed in the limbs. They are most frequent in the neck, and not uncommonly surround the carotid vessels, or the trachea, or œsophagus. They may occur in the mouth, and have been found beneath or involving the tongue.

DIAGNOSIS.—In the head we must distinguish these tumors from meningocele, cancer, fatty tumors, nævus, and sebaceous cysts.

TREATMENT.—These tumors, if not involving important structures, ought to be removed as soon as the child is strong enough to undergo the operation; for although they occasionally disappear spontaneously, they are yet very liable and at any time to grow rapidly and destroy life; and the older the child, the more dangerous the operation for their removal. If the tumor involves important structures, it may be left so long as it appears disinclined to increase, when an operation if practicable should be performed.

Fatty tumors occur congenitally, although rarely. Their removal is usually not difficult.

Dermoid cystic tumors, containing sebaceous matter or serous fluid, or both, and hairs usually grow from the lining membrane. These tumors are very commonly found in the region of the upper and outer border of the orbits. They are very movable beneath the skin, but although they may appear superficially situated they often extend deeply.

TREATMENT.—It is necessary to dissect the growth out carefully as soon as the child is strong enough to undergo the operation, otherwise they will increase in size both superficially and deeply, and their removal become much more difficult and dangerous.

Sebaceous Tumors.—The common form of these tumors may occur congenitally, and as they are liable to penetrate through the tables of the skull, they should be carefully removed as early as practicable.

Nævus consists in an abnormal dilatation or enlargement of capillary bloodvessels. They are found in the skin and mucous membrane, or in the subjacent cellular tissue in all parts of the body.

DIAGNOSIS.—Those situated superficially are readily diagnosed; those beneath the skin must be distinguished from fatty and other tumors. Nævi swell and assume a darker color when the child makes any violent expira-

tory effort, as in crying, etc. If the nævus is too deep to be distinguished by this symptom, it may be punctured with a grooved needle. A meningocele has been mistaken for a nævus, and Mr. Holmes has known a cancer of the bones of the skull operated on for a vascular tumor.

TREATMENT.—If situated over bone, pressure may be tried. Operation is desirable early, as the nævus may at any time increase rapidly. The following are the means one or other of which is usually adopted.

1. Excision by the knife. 2. Ligature. 3. Caustics. 4. Setons.

Excision may be employed when it is desirable to preserve the skin. There is some danger of secondary hemorrhage. *Ligature* is most useful in the majority of cases. *Caustics* are useful for small nævi. *Setons* may be used in some cases when excision is contraindicated.

We may add that the injection of strong solution of iron is very dangerous, especially in the case of nævi of the face and neck. The solution carried to the heart has caused thrombosis and quick death. Vaccination upon the nævus is an unsatisfactory plan of dealing with these cases.

Moles.

THE INFLUENCE OF IMAGINATION ON THE EMBRYO.—In all ages speculation, contention, and imagination have been exercised upon this problem. Credulity has been met by ridicule. Is there scope for a philosophical discussion and conclusions between these two extremes of unreason? We believe there is, but we cannot indulge in it here. We will simply try to state the case.

A woman brings forth a fœtus, single or double, presenting some deformity. She or her friends then recollect that at some time during gestation she had been impressed by some object more or less resembling the misshapen child. It has been objected—1, that the "impression" was an after-thought hunted up in the memory, and greatly an image built up after the birth upon slender foundation; 2, that if there had been any "impression" it was so slight and transient that it could not be supposed to have had any influence; 3, that very marked "impressions" are often experienced by women during gestation, exciting in them the dread that the child will be affected, and yet the child is born faultless; 4, that if occasionally a monstrosity is born to a woman who had made known an "impression" at the time it was received, it must be regarded as a coincidence; 5, that deformities, similar to those which have been ascribed to mental impressions, are frequently observed where no such impressions have been noticed; 6, that the deformities can all be traced to faults of development which admit of interpretation according to the known laws of embryology; 7, that it is not possible to understand how an embryo which has followed the normal development down to the moment of the alleged impression can thence undergo changes of form—for example, an anencephalous fœtus is born; how can the sight of an anencephalous child destroy the brain of a fœtus developed to five months? 8, that monstrosities are frequent in the lower animals, and in birds, and in plants; 9, that many deformities and peculiarities may be traced to heredity, especially from the father. How do we account for women, married to mutilated men without legs or arms, bringing forth well-formed children?

The following facts deserve attention. Mares are known to bring forth foals bearing the characters of the sire, and this not once but several times, although the subsequent foals have been begotten by different horses from the first. Thus Rollins asserts that the common mule from the ass and horse is particularly apt to have bars on its legs. According to Mr. Gosse, in certain parts of the United States about nine mules out of ten have striped legs. This may be accounted for on the theory of heredity. But there is the famous case of Lord Morton's hybrid from a chestnut mare and

a male quagga. Not only the hybrid, but even the pure offspring subsequently produced from the mare by a black Arabian sire were much more plainly barred across the legs than the pure quagga. Darwin, so rich in observation of natural experiments, records many facts and speculations illustrative of this problem. This history of the mare and quagga is in harmony with many facts known to breeders, which tend to show that the first sire stamps his mark upon all the subsequent offspring of a mare. Can heredity explain this? Does imagination or mental impression arising in the mare influence the result? Are we justified in concluding that the mare and other animals are not, like women, subject to "impressions?"

It may be explained on the hypothesis of Dr. Harvey, of Aberdeen, whose researches on cognate subjects are so full of interest, namely, that the blood of the mother (we should rather say the intimate molecular tissue-structure) had been contaminated by her first pregnancy, and had acquired some of the peculiarities of the first fœtus which it had nourished. The deterioration in temper and spirit which is known to ensue to a mare in foal by a donkey is strong evidence in point.

THE INFLUENCE OF IMAGINATION THROUGH THE FATHER.—Captain Speake relates the following story: "Having shot a pregnant Kudu doe, I directed my native huntsman, a married man, to dissect her womb and expose the embryo; but he shrank with horror, fearing lest the kid striking his mind, should have an influence on his wife's future bearing, by metamorphosing her pregnancy to the likeness of a fawn!"

Can a strong prepossession existing in the father's mind before and at the time of fruitful intercourse influence the form of the child?

The children of drunkards often exhibit in their physical as well as mental features traces of the paternal vice. "Ebrii gignunt ebrios," says Plutarch.

DISEASES OF THE NERVOUS SYSTEM. *Brain Disease.*—Jacobi, of New York, says a frequent cause of epilepsy is premature synostosis of the cranial bones. The brain diseases attributed to syphilis will be stated when giving the history of syphilis in the fœtus.

Encephalitis and Myelitis.—Virchow says many new-born infants said to die of apoplexy have in reality died of encephalitis and myelitis. The alteration consists in fatty metamorphosis of the cells of the nerve-tissue. These elements increase in size, become filled with fat-globules, and for some time form large round granular bodies in which the nucleus soon disappears. These granular bodies and masses of fat-globules have their seat particularly in the white substance. Virchow thinks this change is the result of inflammation. He has observed it chiefly in cases of syphilis and of the acute exanthems in which the mother alone has been affected. He asks: May not this condition have an active influence upon the production of infantile paralysis and icterus?

DISEASES OF THE EYE.—The late Mr. Critchett informed us that he had repeatedly seen cataract fully formed and involving the entire lens during the first few weeks, in which the pupil was perfectly active, the conjunctiva and cornea healthy, and no trace of inflammation in any structure of the eye. Cases in which the opacity is limited to the nucleus of the lens are singularly illustrative of the intrauterine character of congenital cataract.

CONVULSIONS may take place *in utero*, and the fœtus may die in consequence. The mother is conscious of violent movements of the child, and the child has shortly afterwards been dead-born. The cause may be some blood-taint communicated from the mother, pathogenetic, or from extraneous poison, as strychnine; or the convulsions may be from ague.

More commonly, probably, convulsions are the result of tubercular men-

ingitis, of inflammation or malformation of the nervous centres. Hydrocephalus is certainly an intrauterine disease, and connected with tubercle.

BRONCHOCELE, OR GOITRE.—Cases are collected by Simpson and F. Weber.

SCLEREMA, SKIN-BOUND ICHTHYOSIS.—Specimens are found in various museums. There is one in Guy's.

Mechanical Conditions Causing the Death of the Fœtus.

TORSION, KNOTTING, OR STRANGULATION OF THE CORD.—Many instances are recorded in which death of the fœtus was apparently produced in this way. Of the sufficiency of this condition there cannot be a doubt. Tying the umbilical cord so as to render the vessels impermeable is equivalent to tying the pulmonary vessels or the trachea of the adult. Asphyxia results. Most museums exhibit specimens of twisted and knotted cords. The embryo and fœtus up to an advanced period of gestation preserve great mobility in the uterus, especially where the proportion of liquor amnii is large. Severe exertion, the action of the abdominal muscles, as in defecation, may change the position of the fœtus. External pressure, as in copulation, may cause the fœtus to rotate. But how do we explain knots? The embryo must pass through a loop of cord, and thus commit suicide. Sometimes it stops short of strangulation. Indeed, complicated knots have been found on the cord, the child being born alive.[1] It is a familiar fact that the neck of the child may at birth be encircled by one, two, or even three rings of umbilical cord. This may be regarded as the first stage of knotting. The fœtus does not pass through the loop, it is caught at the neck. In these cases the child does not often perish *in utero*. The danger comes at the time of labor, when, the head descending, the cord is tightened. If this be cut in time the child is saved. The most obvious cause is the undue length of the cord, so that it settles in loops at the lower part of the uterus. Dohrn[2] gives a good account of torsion and the ensuing stenoses of the cord. Ruysch and D'Outrepont described them. Meckel[3] affirmed that they are due to revolutions of the fœtus, and that they are more frequent in male children. About 0.75 inch from the umbilicus is the *locus minoris resistentiæ*. Where twistings produce morbid results, Hohl thinks they take place when the head of the fœtus rests upon the floor of the ovum; and that strictures rarely occur in mature children. Dohrn narrates a case. A woman conceived in December; in June she lost sensation of the child, presumably from a fright; in the December following, labor set in; no hemorrhage; a female fœtus of seven months was born by breech, macerated and shrivelled. The cord was twisted twenty-eight times from right to left, and at its fœtal end was a strong constriction three inches long. The navel was dragged out. The vessels were permeable, but much narrowed. There was no thickening and no Wharton's jelly at this part.

In far the greater number of cases in which local stenoses occurred, the cord was found in the rest of its length to have numerous windings. Meckel once found ninety-five turns on a cord 11 inches long. On the other hand, several instances are given in which partially stenosed cords were only slightly wound in the rest of their course. But even here axial turnings of the fœtus may be the cause. The accident appears in many cases to have followed violent shocks.

[1] R. U. West, Brit. Med. Journ.
[2] Monatsschr. f. Geburtsk., 1861.
[3] Müller's Archiv.

Dohrn found the cord twisted from right to left in 11 cases, from left to right in 9. In most instances the fœtus perished at seven months. Where the fœtus had been dead some time, the placenta was found atrophied, sometimes with numerous apoplexies. In some of the cases the fœtus was hemicephalic.

Chiari, Braun, and Spaeth[1] describe atresia of the cord resulting from the compression of amniotic bands.

Twins have destroyed each other by their cords getting entangled, or from one fœtus passing through a loop in the cord of its companion. Figures of the varieties of knots are given in Martin's "Atlas."

The serous membranes.

PERITONITIS.—Simpson has collected and observed several cases. *Some are referable to the mother.* Thus in some cases the mother had been exposed to cold, fatigue, or injury, to general ill-health; in one case the mother herself had been twice attacked with peritonitis during gestation, suffering at the same time with syphilis. In other cases, also, the mother had venereal symptoms. Other cases are more epecially attributed *to the fœtus.*

Strangulation of the intestine, closure of the urethra, and retention of urine have been noted. The peritonitis may prove fatal during gestation. The child is rarely born alive. In most cases the disease is independent of syphilis. Simpson relates a history of twins, in which one fœtus had died of peritonitis, the other being born alive, healthy. Peritonitis is probably in all cases secondary upon other morbid conditions. The distention of the abdomen may be so great as to be the cause of dystocia.

Pleuritis has been very rarely observed.

Rickets not unfrequently begins in uterine life. Winckler describes two forms—the *Rachitis micromelica* and *R. annulans.* The first is characterized by marked shortening of the extremities and thickened diaphyses; the annulans may pass into the micromelica, and has a doubtful practical value. The causes are obscure. It can hardly be assigned essentially to faulty nutrition, since, in the case of twins, one fœtus has been found rickety, the other healthy (Klein).

Struma has been observed.

Syphilis is one of the best recognized diseases of the fœtus. Its action is seen on the skin, in the thymus, lungs, liver, spleen, suprarenal capsules, pancreas, intestines, serous membranes, and bones; most frequently in the bones and spleen. As Spiegelberg remarks, the alterations are best marked in fœtuses which had approached term, less so in those which had perished early. In these last the diseases had not become developed, and maceration will have changed the appearances. The *skin* shows numerous ecchymoses and subcutaneous indurations. Vesicular formations, as pemphigus, varicella, syphilitica confluens. Sometimes the blebs contain pus, or blood-colored fluid. They are most frequent on the volar aspect of the hands and feet, fingers and toes. When confluent, the corium lies bare in large areas, and sometimes the skin peels off the living child in large pieces from the hand and foot. This condition observed in the live child during labor may be taken for maceration. In some cases bleb-formations have been noticed as epidemic. On the *mucous membrane* of the mouth, nose, throat, air-passages, may be seen spots and cracks sometimes passing into suppuration, so that defects are caused in the palate, and the vocal cords may be partly destroyed.

The *serous membranes* may, like the skin, show numerous spots, and blood-tinged serum in the cavities. Martin described this as *hydrops sanguinolentus*, and as characteristic of syphilis. But Spiegelberg says a similar condition may be produced by maceration.

[1] Klinik der Geburtsk., 1855.

When the *thymus* is affected, it is enlarged, and contains small abscesses (Dubois).

In the *lungs* and large organs of the abdomen the changes are more frequent and important. They appear in the form of gummata, neoplasms of cells, which are doomed to degeneration, as in the visceral syphilis of adults; and it is these degenerations which, if they do not kill during intrauterine life, do so after birth.

In the lungs one meets numerous knots, the size of a pea, separated from the surrounding parenchyma by a paler color; at first grayish-red, then, in later stages, yellowish: they soften and contain cheesy pus. In more advanced cases one finds in their place brawny cicatrices. Conditions likened to white hepatization or induration are also found.

Cory thus describes the liver in syphilitic new-born children. The liver was large, weighing 195 grammes, or at least three times the weight of a healthy fœtus. Cut into, the surface of the section was seen light yellow, mottled here and there with patches of normal color. There seemed much increase of connective tissue surrounding the portal vessels, but the hepatic veins were normal. The whole of the gland was studded over with lightish gray spots. In two cases the coils of intestines were glued together by a thin layer of fibrin. The spots were very numerous; they resembled little gummatous growths. Spiegelberg found that in some places the nodules had given place to scars.

The *pancreas* exhibits changes similar to those seen in the liver. There are interstitial hypertrophy and induration, so that the organ is enlarged and heavier.

The *spleen* enlargement is one of the most common conditions. It is even found in the macerated fœtus.

The *suprarenal capsules* are not often diseased.

In the *osseous system*, changes in the cranial bones are the least frequent, and even these are most rare in the inner plate. But, according to Wagner, changes in the long bones are almost constant. Disease never fails at the transition point of the bony diaphyses into the cartilages of the epiphyses. The lower end of the femur shows the greatest change. In addition to the osteochondritis, a change in the medulla, either diffuse or *in foci*, occurs.

Intrauterine death of the fœtus offers many points of pathological and clinical interest. Whatever the cause, the issue is almost necessarily in abortion. The history given of the diseases of gestation, maternal and fœtal, comprises the etiology of this event. It is in this study that we must seek for the rational indications for prevention. It is a matter of clinical observation that some women habitually bring forth dead children. It is probable that in such cases the same conditions which led to the first death continued to operate. The hypothesis has been maintained that the *habit of aborting* may be acquired independently of disease. This is not quite without a physiological foundation. We have observed that in cases in which labor has been provoked artificially in successive gestations, the response to provocative measures is more and more easy in proportion to the number of times provocation is had recourse to, so that at last the labor seems to set in almost spontaneously at the wonted time. In these cases the child may be living. But this can hardly apply to the child's death. We can hardly imagine that the child dies in successive gestations through the influence of habit in the mother. We are compelled to postulate disease either in the mother or in the fœtus.

Whenever, then, a woman brings forth a dead child—that is, one which had died before labor, we must search by dissection of the body, by nation of the placenta, and of the mother and father, clinically

torically, for the probable cause, and direct our treatment acco
cases where syphilitic taint is suspected, the treatment must
the father as well as the mother, even before a new gestation is
thorough course at Aix-les-Bains is, perhaps, the most efficien
being available, the recognized treatment must be punctilio
When a gestation has begun, the mother should continue th
Chlorate of potash, much extolled by Simpson, has given us h
In those cases in which two or more children have died before
be wise to bring on labor before the time at which death had b
to take place in preceding gestations. In this way the child bo
be subjected to direct and more effective treatment.

THE SIGNS OF DEATH OF THE CHILD IN UTERO.—These c
first place, in the negation of the signs of life, as the failure
heart, the failure of the movements; and, secondly, in certain
point to the arrest of the process of development. The mothe
signs of disorder of digestion, shivering, a dull, pallid aspect, fa
of cold and weight in the hypogastrium and pelvis, as if she
a foreign body; the cessation of the progressive development of t
abdomen, the uterus becoming even smaller, its rhythmical mo
haps no longer felt; its sinking lower down and getting softer
ance of reddish watery discharge; the breasts becoming flaccid a
ing. The temperature of the uterus falls. The characteristic
the vagina fades when the child dies. Should the os uteri adm
nation by finger, it may be found that the fœtus no longer fl
amnii; this may have been discharged; and sometimes the
bones may be felt wabbling under the flaccid scalp, and shreds o
come away. In this case the diagnosis is certain. The e
emptying the uterus now must be considered. The diagno
dead fœtus in utero and other conditions is not seldom very dif

The changes which the dead fœtus undergoes in utero consi
maceration and mummification. In the case of very early
plete disappearance may take place through fatty liquefaction,
rise to the hypothesis of absorption. But after the fourth mont
this process can hardly take place. The nature of the chang
somewhat upon whether or no air be excluded from the uterus
liquor amnii be discharged or present.

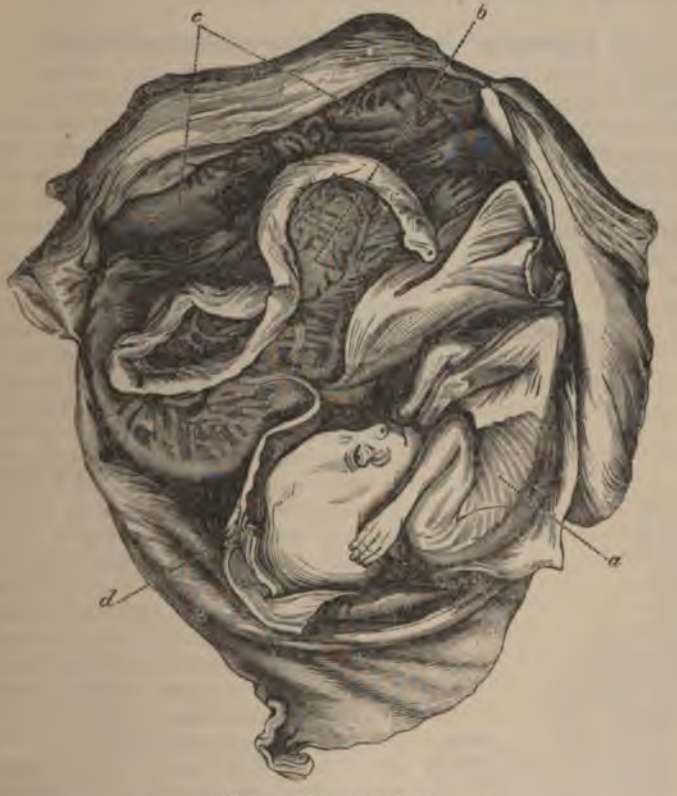
If the liquor amnii remain, the process of *maceration* take
soft parts fall off in shreds. The cuticle gives way first; it
blebs and is easily detached. The corium is swollen and reddi
infiltration with blood-serum. The inner tissue becomes flacc
infiltrated with hæmatin. Blood-stained fluid collects in the s
the abdomen is sometimes so distended in this way that it burs
is soon transformed into a grayish-red pulp. The liver
greatest changes. The joints soften and break down, so that
fall apart. The placenta becomes soft, and its vessels blood
becomes soft and discolored; it becomes thick at the fœtal e
torn. The membranes resist maceration for a longer time (se

Mummification takes place, especially when the fœtus is dry.
the condition seen in alcoholic preparations. The subcutane
tissue disappears; the skin lies immediately on the muscles; t
muscles is uniformly dark-red. In the serous cavities only
fluid are found. The intestines are small and soft. The sha
may be preserved, but frequently it is flattened according to
which it has been subjected.

Mummification occurs especially in twin gestation, affecting the fœtus, which dies, when the umbilical cord, twisting or knotting, causes death.

The dead ovum may be retained a long time *in utero*. Usually it will be expelled in about three weeks. Retention is not necessarily, perhaps rarely, the occasion of serious danger to the mother.

FIG. 104.



MUMMIFICATION OF FŒTUS.

a. The shrivelled fœtus. *b*. Placenta. *c*. Membranes. *d*. Membranes.

The Intrauterine, or Prenatal, Treatment of the Fœtus.—The initiative in the medical treatment of the unborn child was taken by Sir J. Y. Simpson. He sought to combat the syphilitic diathesis by giving the mother chlorate of potash. His hypothesis was that from the large amount of oxygen contained in this salt the mother's blood became more highly oxygenated, and morbid processes were thereby counteracted. The improved oxygenated blood of the mother imparted a similar condition to the blood and tissues of the fœtus. This hypothesis is difficult of rigorous proof; but it is full of interest, perhaps pregnant with important applications. Clinical observations afford at least presumptive evidence of its truth. For example, a woman brings forth a succession of syphilitic infants, born dead, or exhibiting the disease soon after birth.

In succeeding gestations she is treated with mercury, iodine, chlorate of potash, and she brings forth healthy children. Thorburn, in a most suggestive memoir,[1] follows up this by interesting clinical observations. In syphilitic cases he has obtained good results from mercurial treatment. In the neurotic diseases he has seen good effects from bromide of potassium. We also, as well as others who have followed Simpson, have seen women who in successive pregnancies had brought forth dead or diseased children prematurely, carry on to term, and at last bear healthy children.

[1] Liverpool and Manchester Med. and Surg. Reports, 1875.

CHAPTER XIV.

DISEASES OF THE PLACENTA.

Having traced the diseases which, on the one hand, seem primarily to affect the mother, and on the other traced those which seem primarily to affect the embryo, we may on this physiological basis study the diseases which affect the placenta, the intermediate organ. In this structure the two organisms, maternal and fœtal, meet, and exert a reciprocal influence.

The full description of the placenta, and of the relations between mother and fœtus, given in the first chapters, renders it unnecessary to give more than such a brief recapitulation here as will enable us to trace the pathology of the placenta upon its proper anatomical and physiological foundations. We shall for this purpose state concisely the results obtained by the original investigations of Robert Barnes and Hassall, published in the "Medico-Chirurgical Transactions," 1851, and those of Robert Barnes in the "British and Foreign Medico-Chirurgical Review," 1854–5–6.

The generally received doctrine of the anatomy of the placenta may be thus briefly stated. The organ is made up of a maternal and a fœtal portion. The maternal portion consists of the utero-placental vessels, arteries, and veins, preserving an unbroken continuity; these vessels on entering the placenta push before them a thin investment of decidua, a membrane derived from the inner wall of the uterus. On the other hand, the fœtal portion consists of the fœtal-placental or umbilical vessels, arteries, and veins, also perfectly continuous; these, which branch out from the umbilical cord on entering the placenta, carry before them an investment of chorion, the external membrane of the ovum. In the substance of the placenta these two portions, maternal and fœtal, come into apposition. The changes effected between the blood circulating in the separate systems are wrought through the walls of the containing vessels and their decidual and chorionic investments.

Fig. 105.

A CHORION-VILLUS CONTAINING BLOOD-VESSEL FILLED WITH BLOOD GLOBULES, NORMAL. (Robert Barnes.)

Goodsir's description differs in one point from that of Barnes and Hassall. He maintains that the cells found investing the villi are continued from the decidua. "I saw that the great system of cells was a portion of the decidua *all but cut off* from the principal mass by the enormous development of the decidual vascular network, but *still connected with it by minute files of cells which fill the cavities of the placental threads.*" It appears to us that decisive facts disprove the correctness of this view. 1. The structure of the membrane investing the umbilical capillaries which he describes as decidua is essentially different from that of decidua observed elsewhere. 2. The continuity of this membrane with the decidua is not clearly demonstrated.

centa in the intensely livid hue and swelling of the face of the child, arising from stagnation of the blood from long-continued pressure. These are examples of fœtal or chorionic congestion. If we bring to our aid the physiological homology of the placenta and the air-breathing lung, we shall have no difficulty in understanding how the placenta may be exposed to congestion, inflammation, and effusions from analogous causes to those which induce similar lesions in the lung. In the adult death by asphyxia is read in the lung; in the fœtus, it is read in the placenta. The true fœtal trachea is constituted by the utero-placental arteries, which convey to the cavernous structure of the placenta the oxygenated blood of the mother. If this flow be intercepted, the fœtus dies of suffocation. If blood not duly oxygenated, or blood impregnated with some noxious ingredient, is supplied, again, the fœtus dies of asphyxia, or of poison, just as the adult would perish if made to inhale carbonic acid. This is illustrated by the following observations, which answer to all the requirements of experiments *ad hoc*. A case occurred in which we deemed it necessary to bring on labor at the seventh month. When the labor had made some progress the cord fell through into the vagina. Thus the pulse of the unborn child could be watched. When the uterus was quiescent, the pulsations of the cord were 80 in the minute and strong. The torpid uterus was roused to action by galvanism. During every contraction so induced, the pulsations became first intermitting, feeble, then stopped. Had not the galvanic stimulus been withdrawn, the child must have died of asphyxia. Being withdrawn, blood flowed again into the placenta, the fœtal circulation was again set in motion, and the pulsations returned. Presently, uterine contractions came on spontaneously. The same phenomena were observed. In another case the child was born prematurely, scarcely viable; the uterus contracted strongly; the cord was not tied. The firm contraction arrested the placental circulation. The child's life depended upon breathing air. It gasped feebly; the heart beat 90 in the minute. The gasp at an end, the pulse fell to 60. Respiration excited artificially, the pulse rose at once to 90, and dropped again to 60 as respiration ceased. And so, for a considerable time, the pulse ebbed and rose as respiration ceased or returned, and this even after the cord was severed. Now, precisely the same effect upon the heart's beat had been watched by the stethoscope before birth, the pulse falling on uterine contraction, rising during its relaxation. We do not know of any other recorded observations which so conclusively prove the equivalence of aërial and placental respiration. It would be extremely interesting to institute observations upon the influence of asphyxia in the mother upon the placental circulation and thence upon the fœtus. They might be made upon the lower animals.

This form of congestion may be called fœtal. In placentas approaching maturity, fœtal congestion is probably in most cases accompanied by maternal congestion, constituting a mixed form, or general placental congestion. In the same manner as asphyxia in the air-breathing animal induces congestion of the lung, so does interruption to the flow of maternal blood through the placenta—that is, asphyxia in the blood-breathing embryo—induce congestion in the fœtal vessels of the placenta.

The Causes of Blood Extravasation in the Placental Tissue.—Certain tissue alterations of the placenta, as fatty degeneration, are the most constant factors. Other causes are the causes of congestion. Thus all conditions that lead to deterioration of the mother's blood—anæmia and hyperæmia, defective power of circulation, excessive vascular tension—may lead through congestion to extravasation. To enumerate these conditions would be to give a list of all those diseases which cause dyscrasia of the blood, or toxæmia. The zymotics—typhus, smallpox, measles, scarlatina, acute rheu-

matism, acute inflammation, especially pleuritis and pneumonia; m
chronic diseases, as phthisis, scrofula, scurvy, obstructive heart disease,
rhosis of the liver, granular degeneration of the kidneys, some uterin
ovarian diseases; and diseases leading to exhaustion, as hemorrhages
a ctation.

THE FORMS IN WHICH BLOOD EXTRAVASATIONS ARE FOUND IN THE P
CENTA.—The maternal source and seat of hemorrhage are most unequivoca
manifested in early abortion. In young ova the entire decidua is oft
found thickened to an enormous extent by infiltration with blood, part
which is still fluid, part freshly coagulated, part condensed into firm mas
of fibrin. Most commonly the decidual cavity, the space between the
cidua uterina and the decidua reflexa, is free from blood; but the quanti
effused into the substance of the decidua compresses the uterine and reflect
laminæ together, obliterating the cavity. Sometimes the effusion is entire
limited to the decidua; but occasionally some escapes beyond the limits
this membrane, and flows into the loose tissue formed by the villi of t
chorion. Very rarely is the membrane of the chorion or the amnion ruptur
so that blood is found in the cavity of the amnion. When this does happ
it is probably owing to the violent compression exercised by the contracti
uterus during the act of expulsion. But although rarely rupturing t
amniotic sac, the blood effused or forced into the yielding tissue of the cl
rion-villi or new-forming placenta forms rounded masses that push the me
brane of the amnion into irregular knobbed elevations, which, looked at fr
within, have, in their bluish-black color, irregular shape, some resemblar
to varicose veins. This is the condition described by Baudelocque a
Granville as "tuberculated ovum," an unfortunate name, as suggestin
false idea of the pathological nature of the affection. Specimens of o
affected in this manner are to be seen in most museums.

Hemorrhage may also take place between the uterus and the decidua,
between the two layers of the decidua. Sometimes the effused blood for
a uniform layer of considerable thickness lying between the decidua a
chorion, so as completely to invest the ovum.

In ova a little more advanced, that is, when the placenta is marked o
it is very rare to find extravasation of blood in the decidua without a
finding blood in the substance of the placenta. In this structure the bl
is commonly seen in more or less rounded masses, the villi and loose par
chymatous tissue being torn, and sometimes broken up, so that unless p
tions be submitted to microscopic examination the placental tissue might
be recognized.

In ova of a still more advanced period, when the placenta is fully form
the appearances assumed by hemorrhages are different. The decidua is
longer so thick or vascular as in the earlier period; the placenta itself
become the chief seat of vascular development. The almost exclusive s
of blood extravasation is now the body of the placenta.

Blood effusions into the placenta appear in three principal forms: 1. T
extravasated blood forms for itself a wide irregular cavity in the centre
a cotyledon, often communicating with smaller cavities in the vicinity. Th
a cavity of this kind be formed, it is obvious that a considerable quantity
blood must be effused suddenly, and this cannot take place without tearin
or breaking up the delicate tissues. The tissue surrounding the cavity i
stained dark and brown-red by imbibition. Owing to the laceration of th
placental tissue and the compression caused by the effused blood, it is seldo
that we are able to find remains of villi in the extravasation; but in th
periphery of the cavity, villi altered in various ways are detected. Th
condition of the blood will vary according to the length of time it ha

escaped. It may be fluid, semicoagulated, or quite solid. 2. The extravasations may assume a lobular form, and be enclosed in sharply defined cavities, varying in size from that of a bean to that of a walnut. The seat of these may be near the fœtal or the uterine surface, and may cause projections, seen and felt under the normal tissues. 3. Scanzoni describes another form, in which one or more cotyledons are found, dark-colored, hard to the touch, the tissue more fragile, but no cavity containing blood. On section, however, there are seen several pear-shaped, dark-red foci, containing fluid blood, surrounded by hypertrophied tissue. Scanzoni has found this form exclusively in cases in which a long-continued pressure upon the cord, as in breech-births, prolapsus of the cord, etc., has arrested the circulation. He infers that these extravasations arise from rupture of the fœtal vessels.

The Changes undergone by the Effused Blood.—If abortion and exclusion of the placenta do not follow immediately upon hemorrhage into its parenchyma, the blood soon loses its fluidity and dark color. The mass first undergoes a separation into its fibrinous and serous elements. The freed serum partly infiltrating the surrounding healthy tissue is gradually absorbed; part, surrounding for a time the contracting fibrin, serves for a macerating medium, and helps to extract the coloring matter; the fibrin goes on contracting, hardening, and losing color. It is now obvious that through the removal of the serum and the contraction of the fibrin, the fibrin, being all that remains, cannot occupy the same space as the mass originally effused; the placental tissue is not contractile; the surrounding structure does not, at least as a rule, collapse upon the diminished mass. There must, therefore, result a vacant space or cavity. Now *cysts*, or empty cavities of various sizes, sometimes as large as a walnut, are not very unfrequently seen in placentas, and we believe that their formation may be accounted for in the manner described. We have found the tissues immediately surrounding these cysts more hardened than normal, and the villi more or less atrophied, obliterated, or absent. These cysts may properly be called *apoplectic cysts*, and are strikingly analogous in origin to the apoplectic cysts of the brain. The process described, resulting in the formation of cysts, may be looked upon as one of the modes of cure of placental hemorrhage. In one case in which we found five such cysts, accompanied by consolidation of other parts of the placenta, obviously from extravasated blood, gestation went on to the full term, and the child was born alive, although very small and feeble. These cysts, as Millet and Bustamente point out, are generally found on the fœtal surface.

In some cases the extravasation is neither so sudden and extensive as to cause immediate abortion, nor so dependent upon one accidental transient condition as to end in one simple attack, leaving a large portion of the placenta unaffected, and tending to a cure. The morbid conditions may be persistent, even progressive, and the hemorrhage will be recurrent. Some cases of fatty degeneration are of this kind. In such cases we shall witness the appearance so faithfully depicted by Cruveilhier (see Fig. 106). We shall be able to trace in the same placenta all, or the greater number of, the transformations that sanguineous effusions can undergo. Confined to one cotyledon, or extending into several, we shall see a *foyer*, composed of several defined strata concentrically disposed, resembling closely the successively deposited layers of an aneurismal tumor. On making a section of a placenta so affected, the diseased mass will be seen embedded in the tissue proper; the layers of the circumference are composed of fibrin condensed and freed from coloring matter. These are evidently the result of effusion of a date long anterior to the expulsion of the placenta. Internal to these are layers of

fibrin less condensed, and deprived to a less extent of the coloring matter—the result of more recent effusions. The centre is occupied by blood partly coagulated, and still dark-red or black—the result of effusion immediately preceding the expulsion of the placenta. Accompanying this condition, it is usual to find the tissue surrounding the seat of effusion more or less infiltrated with blood, partly indurated from the consolidation of this blood.

Fig. 106.

Apoplexy of placenta. (Cruveilhier.)

In another form of recurrent placental hemorrhage the blood is not extravasated in one or two large *foyers*, as in the preceding case, but in numerous small round masses, dispersed throughout every part of the organ, and having healthy tissue between them. In a placenta affected in this manner, we may sometimes see individual *foyers* exhibiting blood or fibrin in the different stages of metamorphosis that indicate distinct periods of extravasation; and also different *foyers*, some showing the hard, colorless fibrin of long standing, and others consisting entirely of freshly extravasated blood. In such cases there is commonly some disease of the placental

tissues, as fatty degeneration, predisposing the vessels to yield under moderate tension.

Still another form of placental hemorrhage especially deserving attention is that occasioned by partial detachment, as in *placenta prævia*. Here the phenomena presented by extravasation of blood into the placenta may be observed in all their simplicity. The hemorrhage depends upon purely mechanical causes, and the elements of the placenta and the blood itself may be perfectly healthy. Here, also, we have frequently the opportunity of observing the different appearances assumed by different portions of blood poured out at different epochs. It is a familiar fact that when the placenta is implanted on the lower segment of the body of the uterus, the patient is liable to successive hemorrhages occurring at intervals more or less distant. It was advanced by Gendrin, and maintained by J. Y. Simpson, that the occasional arrest of the hemorrhage in these cases was owing to the coagulation of the blood poured into the separated portion of the placenta. This coagulation undoubtedly takes place, but it is not enough to explain the whole case. How the flooding is arrested will be shown when describing placenta prævia. In these cases the blood is certainly maternal. The mother shows unequivocal marks of the loss of blood, whilst the child exhibits no such loss, unless some of the larger umbilical vessels have been accidentally ruptured.

Masses of fibrin are not uncommon in the placenta. What is their *significance?* These facts must be noted. They are frequently found sharply defined in the midst of healthy placental tissue; their most frequent seat is immediately under the fœtal surface. The child is born alive at term. The inference is that these masses have little pathological importance.

Another question is—What is their *origin?* They may be supposed to be the remains of blood extravasations, or simple exudation of fibrin, or of inflammatory effusion. Against the hypothesis of blood clots are the facts that they are perfectly homogeneous, and show no trace of blood-corpuscles or hæmatoidin, thus differing from the apoplectic extravasations last described. Against the inflammation-hypothesis are the facts of the sharp limitation of the masses by healthy tissue and the absence of any symptoms indicative of this process. We believe the most frequent source to be exudation, as fibrin, from the fœtal vessels. The blood of the fœtus is hyperinotic; the seat is almost invariably near the fœtal surface in the neighborhood of the large vessels gathering to run into the cord. Qualifying this statement, however, we must note that a frequent seat of the deposit is round the margin of the placenta near the circular sinus. Of this we have seen remarkable examples, and we made a drawing of one case in which there was a thick layer of yellowish-white fibrin completely encircling the placenta, and which, contracting, had so raised the edge all round as to convert the fœtal surface into a cup. This is described by William Hunter, who calls it pleuritic blood. It is conceivable that this concentric marginal contraction might detach the placenta partially from the uterus, and so cause hemorrhage. Or the contraction might interfere with the circulation in the large umbilical vessels by compressing them. But we have not seen proof of this. Sometimes the mass is distinctly laminated, as if deposited at distinct times.

In one case we thought the cause might be inflammation. The late Mr. Pretty brought a placenta with the following history. The patient had suffered intense pain in the hypogastrium during gestation, depriving her of sleep. She went the full time, and was delivered of a living child. She was a delicate, feeble woman. A considerable portion of the placenta retained the normal appearance externally, but, on cutting into it, numerous

indurated portions were discovered, some having small cavities. One point, isolated, contained a recent coagulum surrounded by indurated tissue. The indurated part felt and cut like liver. The villi in the indurated parts were much smaller than normal, bloodless, some of their ends black and nodulated, their texture brittle. In this case there had probably been inflammatory action, leading to fibrinous effusion and hepatization (?), and partial degeneration of the villi involved from pressure.

Changes Undergone by the Fibrinous Masses.—As in the case of like deposits elsewhere, these masses are prone to fatty metamorphosis. Viewed in the mass, to the naked eye they look like lumps of fat, and for this they have been constantly mistaken. Under the microscope no placental tissue is seen; nothing but fibrillæ of condensed fibrin filled with oil-granules. The "scirrhus," "tubercles," "steatomatous tumors" of older authors are nothing else but deposits of fibrin such as we are now describing. Denman mentions it as "adipose substance," Wilde as "placenta obesa." This condition has also been frequently spoken of as "stearoid" or "fatty degeneration" of the placenta, and on this ground it has been imagined that Robert Barnes's discovery of fatty degeneration of the placenta had been anticipated. The two things are totally distinct. During his researches on the subject, many placentas with these fibrinous deposits were brought to him as examples of fatty degeneration. True fatty degeneration, as will be seen presently, is the granular change of the proper structures of the placenta, not the molecular conversion of accidental masses of effused fibrin.

Inflammation. Placentitis.—*A priori*, inflammation may be predicated as possible. Wherever blood and bloodvessels are found, there, it may be inferred, inflammation may arise; and the blood of both mother and fœtus is hyperinotic. But it is confessedly a difficult study. The most suggestive marks of inflammation are seen in the membranes. A case recorded by Dance as inflammation of the fœtal surface of the placenta is not, to our mind, free from doubt as to its nature. Ollivier's case is less equivocal. The membranes were thickened, whitish, opaque, and villous on their inner surface, and traversed by very fine vessels. The woman had suffered pain and slight fever when four months pregnant. She was delivered at term of a live child. Thickening and opacity of the membranes are not uncommon. We have met with cases in which the membranes were so thick and tough that labor was arrested from this cause. The liquor amnii could not be discharged until an opening was made by puncture in the presenting pouch. The bands and strings occasionally found in the amniotic sac, strangling the fœtal limbs, or making adhesions between the fœtus and membranes or placenta, strongly suggest inflammatory effusions. Dubois takes this view, and says adhesions cause monstrosities.

Inflammation was described by Brachet (1828). He compared placentitis with pneumonia. Hennig says the decidual cells swell, and split into a network of connective tissue. Thus yellow or white septa force themselves between the villous masses. The villi, at first swollen, become compressed and fatty, as well as a great part of the placenta. On the fœtal surface effusions of blood and cysts form, and on the uterine surface brown-red knobs, which, wedge-like, with the apex downwards, penetrate between the villi. Later it assumes the appearance of contracted granular liver (hepatization), and thence leads to adhesions of the membranes or of the placenta to the uterus, and thus to disturbance of the placental stage of labor. The discolored portions, seized by inflammation, shrink, harden to a red, then lemon-colored, knob; the exudation, for the most part of strings of connective tissue, penetrates even into the substance of the uterus, so that it is

difficult to detach the placenta. Or the exudation falls into pus; lobular abscesses form in the placenta (Chiari, Braun, and Spaeth), whence pyæmia of the gravid woman or of the fœtus may arise. The fatty and calcareous changes are of less importance.

The gravid woman feels sometimes at the seat of the internal inflammation, for several weeks, or even months, a dull pain or burning; if peritonitis uteri supervenes, a stabbing or tearing is felt on deep inspiration and in certain positions.

In the *villi* inflammation causes first a gelatinous exudation (molecular infiltration), then the villi atrophy. The fate of the fœtus depends upon the extent of this change.

There is observed a tendency to recurrence of the same placentitis and symptoms in successive gestations.

Chronic Inflammation.—Hennig once saw on the membranes a croupous-like exudation; anastomosing pale threads penetrated to the fœtal surface. A layer was formed which bound amnion and chorion intimately; the membranes were thickened.

In the placenta chronic inflammation appears under the form of connective tissue and thickening of the arteries. This last condition leads to hyperplasia. The lumen of the vessels is narrowed or closed. The remaining villous tissue is compressed, atrophied, fatty. The consequences of this disease of the vessels is serious for the fœtus; enlargement of the heart, causing enduring communication of the cavities, greater filling of the lungs and cyanosis, may ensue.

It must, however, be noted that able observers deny the occurrence of inflammation. Not even the semblance of abscess can be accepted as proof. Robin says what has been taken for inflammation is nothing but a condition characterized by the transformations of blood-effusions in different degrees of progress. What has been regarded as pus consists of fine molecular granulations soluble in acetic acid, with white globules and sometimes red globules. If true pus is found, it comes from the uterine tissues and vessels.

We see strong presumptive evidence that there may be decidual inflammation. Endometritis undoubtedly occurs in the non-pregnant. The condition known as dysmenorrhœa membranacea, depending as it does upon inflammation, does not absolutely exclude pregnancy. The result is commonly abortion. Possibly inflammation of the maternal element of the placenta may arise under the influence of smallpox or scarlatina, diseases which commonly attack all the mucous membranes.

Fibrinous Deposits.—It is interesting to consider the analogy of the structure of the placenta with that of the liver. In both organs there is a large volume of blood slowly moving. It may be surmised that impurities derived from the fœtus coming in contact with the maternal blood may cause precipitation of fibro-albumen. The form and size of the deposits found on the fœtal surface render it probable that they are thrown into the maternal cavernous structure as injected size may be. Villi close around these deposits may be quite healthy, and sometimes atrophied villi are involved in the edges of the fibrinous masses.

Sclerosis.—Bustamente describes as sclerosis an alteration appearing under the form of a red fleshy lobulated smooth mass, homogeneous and dense, resembling the tissue of the thymus. The affected part adheres partly to the fœtal surface of the placenta; the healthy tissue is driven back and compressed. At the level of the mass thus affected the mucous layer covering the maternal surface of the placenta can be detached, which is impossible in the normal state.

Calcareous Deposits.—Not unfrequently the maternal surface of the placenta exhibits a number of whitish opaque specks lying just beneath the decidual membrane. These specks have a gritty feel, and are, in fact, earthy deposit. It is usually amorphous, but sometimes it presents acicular crystals; effervesces freely with hydrochloric acid, and turns yellow with nitrate of silver. The decidua covers the specks like a coat of transparent varnish, but in places the appearance is as if the decidual covering were rubbed off; the earthy specks are then naked. This is accounted for by the tearing away of the placenta from the uterus, some of the decidua remaining behind. Unusual adhesion of the placenta is one of the phenomena observed in this affection. That it is mainly a decidual affection is further seen by tracing the septa between the placental cotyledons; the same deposits are seen in these offshoots from the decidua. Again, the fœtal vessels and other structures show no trace of the affection; they may be quite healthy, full of blood, and the fœtus be born alive, and strong. It is astonishing to observe in some cases how extensive the deposit may be without interfering perceptibly with the function of the placenta or the welfare of the child. In some cases the maternal surface is plated or cased with thick crusts of earthy or bony matter.

These deposits are, in our experience, frequently associated with scrofula, tuberculosis, and poor living. We do not know that this relation has attracted attention. The following case is an apt illustration: Mrs. A., pregnant for the first time, applied to Robert Barnes, when four months gone, on account of retroversion of the womb. This was rectified. She was then apparently in good health. Two months later she came again, suffering from emaciation, night-sweats, diarrhœa, "purulent expectoration streaked with blood, hoarseness," and lately, expectoration of "chalky matter, which she could crumble between her fingers;" vomiting was severe. When labor set in she was extremely reduced, but she was delivered without difficulty of a full-sized vigorous boy. The maternal surface of the placenta was everywhere studded with minute points of calcareous matter embedded in a soft cartilaginous-like substance. The placenta, in other respects, was normal. The patient sank, exhausted by phthisis, three weeks after labor. In another case the alteration was noted in three successive labors. The woman was of marked scrofulous diathesis, and at each labor had mammary abscess, also a frequent complication of the scrofulous diathesis. When these calcareous deposits are found in healthy subjects they may be regarded as simple deposits of excess of the calcareous matter called for by the fœtus.

The connection between calcareous deposit in the placenta and phthisis is very suggestive, and more so if we take into account the osteophytic deposits occasionally observed in the membranes of the brain. That it should occur in the lung of the mother, and in the fœtal homologue, the placenta, is very remarkable. It deserves to be noted that the deposit takes place in maternal structure—that is, in the decidua.

Another form of chalk-alteration is seen in the *fœtal vessels*. The significance of this is quite distinct from that of the decidual kind just described. Lobstein noticed this form. It has been taken to be atheroma of the placental vessels. In our experience it is more commonly found in association with fatty degeneration of the fœtal villi and vessels. The ends of the villi become opaque; the villi and their bloodvessels lose their functional capacity; blood ceases to circulate in them; and consequently if the affection extends to a considerable portion of the placenta, the fœtus dies. In this respect, then, the calcareous affection of the fœtal structures differs from that which attacks the maternal structures. It is, however, possible that both forms may be found together.

Chalk concretions are also found in the *fibrinous masses* effused in the placenta.

It is interesting to note that there seems a special tendency to the chalky deposit or conversion in the uterus and adjacent structures. This is seen in phleboliths, in the calcareous investment of the fœtus in ectopic gestation, in the calcification of fibroid tumors. We must also bear in mind the special want of calcareous matter to build up the fœtal skeleton.

ŒDEMA, OR DROPSY OF THE PLACENTA, is not uncommon. Occasionally we see a placenta greatly exceeding the normal bulk, friable, paler than natural, and full of water. If suspended, a large quantity of thin serous fluid will ooze away, and the residual placental tissue may be found somewhat greater in bulk and weight than the normal placenta of corresponding age. The conditions which we have observed in connection with dropsy are: (1) dyscrasia, hydræmia of the mother; (2) sometimes the mother has anasarca or ascites; these two conditions may arise from heart, liver, or kidney disease in the mother; thus we have found albuminuria to coexist; (3) dropsy and peritonitis of the fœtus.

Dropsy of the placenta almost necessarily entails hypertrophy of the placental villi. When watery blood, deficient in nutritive and oxygenating power, is brought to the placenta from the mother, an attempt is made to compensate for the loss in concentration of power by calling into requisition a larger quantity of the inferior or diluted blood. The fœtal villi and vessels grow—that is, undergo hypertrophy—in order to carry the increased volume. Some degree of fatty degeneration is commonly observed.

The issue is commonly death of the fœtus or premature labor. Abortion may be provoked in two ways: (1) the expansion of the placental tissue may not keep pace with the wants of the fœtus, so that it is killed at six, seven, or eight months, and so labor comes on prematurely; (2) the bulk of the placenta may become so great and increase so rapidly as to exceed the accommodating capacity of the uterus, and so labor is excited. In such case the fœtus may be born alive.

HYPERTROPHY AND ATROPHY are more especially affections of the fœtal placenta. It is necessary to distinguish hypertrophy from hyperplasia. Hypertrophy strictly means increased expansion or growth of normal structures. Hyperplasia implies the addition of new matter outside or in the substance of the proper tissues. It may, however, be said that hyperplasia generally involves more or less hypertrophy. The placenta must keep pace in bulk and efficiency with the development of the fœtus. Generally speaking there is a relation in size between the fœtus and the placenta. Gassner demonstrated this by weighing. If the maternal blood is rich, a smaller placenta may suffice; if, on the other hand, the maternal blood be poor and watery, more placental tissue is required. In this condition we find one cause of hypertrophy.

The anatomical condition consists in an enormous multiplication of the capillary fœtal vessels. These vessels and the chorion may, to the microscope, reveal little alteration of structure.

It appears to us that Ercolani has confounded true hypertrophy with hyperplasia and fibrosis.

Atrophy, like hypertrophy, is generally a secondary disease. The example described and figured by Cruveilhier as atrophy of the placenta, we believe to be an example of fatty metamorphosis occurring after the death of the fœtus. Atrophy may be produced as the result of pressure upon the fœtal vessels by effusions into the substance of the placenta; or it may result from failing innate powers of the fœtus. An atrophied placenta is small, pale. Some villi may be found comparatively sound, and carrying red blood; but

even in this case the villi will be paler than the healthy placenta. Points on the maternal surface, generally in the middle of the cotyledons, show recent vascular connection with the uterus—that is, the maternal element of the placenta retains some degree of vitality.

PIGMENTATION.—Ercolani figures a fine example of *melanosis* in the cells of the serotina. Hennig states that pigment is found in the villi and their stalks after chronic stases, as from heart-disease and blood-disease of the fœtus.

TUMORS have been described by Danyau and others. He is probably right in regarding them as due to sanguineous effusions. A remarkable example in St. George's Museum (xviii–8*a*), which we have examined, is of this nature.

It may be stated provisionally as a general proposition, that most of the morbid alterations observed in the placenta have their origin in exudations or extravasations of blood or of the elements of blood.

SYPHILITIC PLACENTA.—Virchow describes an aborted ovum of from two to three months, which had come from a woman who became affected with syphilis after marriage. The chief change was in the maternal part. The decidua was formed on an *endometritis papulosa et tuberosa*. He considers it probable that the tubercles were condylomata, having observed similar conditions of the mucous membrane of the uterus of syphilitic patients. Dohrn describes and figures[1] a case illustrating Virchow's views. Ercolani, however, says that researches on syphilitic lesions show that a form of disease regarded as analogous to the broad condylomata or the mucous papulæ of Virchow occurs also in placentas whence the venereal element is excluded, and is nothing more than an angioma. This view is adopted by Hennig. We think, however, the presumption in favor of a special decidual affection due to syphilis is very strong. The uterine mucous membrane can hardly escape the fate of mucous membranes elsewhere. Upon this point Lebert should be consulted.

FATTY DEGENERATION OF THE PLACENTA.—This affection and its importance as a cause of death of the embryo, hemorrhage, and abortion was first described by Robert Barnes.[2] Under the title, "A New Disease of the Placenta," the publication of this discovery had been partially anticipated by Kilian.[3] Soon afterwards other observers, especially Robin, made further investigations. It is the same disease that attacks the heart, vessels of the brain, liver, kidney, and muscles of the adult. In proportion as it advances it unfits the structures attacked for the performance of their functions; and hence, in proportion to the importance of these functions, the life of the subject is imperilled. It attacks both the maternal and fœtal elements of the placenta; it cannot be always shown which was the first to suffer, but it is almost certain that the other will soon fall under the like degeneration.

It is desirable at the outset to distinguish between fatty degeneration, an affection beginning in living tissues, and fatty metamorphosis, a change which takes place in dead tissues.

FATTY METAMORPHOSIS.—When a placenta is retained *in utero* after the death of the embryo, it is liable to undergo fatty conversion, a change analogous to the adipocerous. It is marked by the general or universal character of the change, every part of the decidual and chorionic structures being nearly equally affected. No blood is found in the chorionic vessels; the proper chorionic investment of the vessels is lost in granular fat; it easily separates from the vessels, and the vessels themselves hardly show traces of

[1] Mon. f. Geburtsk., 1868.
[2] Med.-Chir. Trans., Feb. 1851.
[3] Neue Zeitshr. f. Geburtsk., 1850.

their proper structure. To the naked eye the placenta is smaller than normal; it is pale, of a more or less fatty appearance, very *friable* instead of lacerable, like the normal placenta. On the maternal surface it may still show remains of recent vascular connection with the uterus. Generally in the centre of the cotyledons will be seen a blood-point or clot, the mark of a vessel torn on separation from the uterus.

True fatty degeneration differs widely from the above description. In the first place it is generally partial, invading one or more cotyledons or part of them, forming in many cases diseased masses embedded in comparatively healthy tissue, thus giving evidence that it originated during the life of the fœtus. In some cases we find, indeed, a living fœtus with a placenta in part affected; in others we find the disease more advanced and the fœtus dead, but with some healthy placenta, the vessels still containing blood. To the naked eye the fatty placenta may exhibit masses of yellowish pale color, more solid than the spongy, healthy tissues surrounding them, and easily friable. Under the microscope we distinguish the precise tissues affected.

FIG. 107.

DECIDUAL CELLS IN FATTY DEGENERATION. (ROBERT BARNES.)

The maternal element or decidua presents the characters drawn in Fig. 107. The decidual cells are studded over with minute spherules of oil, some are also on the surface, some on the coats of the vessels and in the cavities of the cells. In some cases there is also evidence of fibrosis of this membrane.

The fœtal portion, consisting of subdivisions of the umbilical vessels, and their chorionic investment, presents the following features. On placing a small portion in water, the first thing that strikes the eye is that the tufts of villi do not expand or float out as does healthy placenta, and on teasing with needles the extreme brittleness of the structure is apparent. Viewed with a half-inch object-glass, the villi are seen much broken up, opaque,

darker than usual, especially near their terminations, which reflect a yellowish color. Magnified 420 diam., the villi are seen thickly studded with minute spherules of oil (see Fig. 108); the chorion is much altered, thickened, the nuclei are lost; the walls of the vessels have also lost their nuclei; spherules of oil are contained, some in the chorion, some in the walls of the bloodvessels, and many in the intervals or spaces between them; the cavities of the vessels are mostly free from fatty deposition; lastly, the vessels are destitute of blood. Some lobes which present to the naked eye a normal

FIG. 108.

VILLI IN FATTY DEGENERATION. (ROBERT BARNES.)

A. Vessels invested with chorion. B. Vessels denuded of chorion, void of blood.

appearance, yet show clear evidence of the same destructive change in progress; considerable fatty change is visible, and the nuclear structure of the walls of the bloodvessels and of the chorion is to some extent invaded. In these portions the distribution of the oil-molecules coincides with the course of the blood in the vessels. This observation shows that the condition of the blood itself is intimately connected with the origin of the deposit.

What are the consequences of fatty degeneration of the placenta? 1. It leads to *abortion*. If the change begins in the chorion or fœtal vessels, these structures become unfitted for their functions; circulation of blood and osmosis cease. If only a small portion of the fœtal villi be affected, the remainder of the placenta may suffice for the nutrition of the fœtus, which may be born alive. If the affection be at all extensive, the fœtus will perish. When the fœtus perishes, the utero-placental circulation quickly flags and ceases. The next step is gradual atrophy of the placenta, of the utero-placental vessels, and decidua. These last retain for a time an impaired connection with the uterus. The fœtal portion has perished with the embryo;

the maternal portion, as a uterine structure, lingers on. This is especially the case in early abortion, where the cause appears to have had its origin in the embryo. The developmental attraction ceasing, the uterus itself is passing into retrogressive atrophy. Contracting upon itself, its capacity diminishes, and so soon as its walls press upon the contained ovum, the diastaltic function is excited, and active contractions—labor pains—setting in, complete the detachment and expulsion of the ovum.

There is an interesting illustration of this theory in that case of twin-pregnancy in which one embryo perishes at an early period of gestation whilst the other lives on. The dead ovum is not cast off, because the development of the uterus is kept up by the stimulus of the living embryo. The placenta of the dead fœtus runs into fatty metamorphosis, maintaining only a very slight vascular connection with the uterus.

If, on the other hand, the fatty degeneration begin in the decidua, as it is likely to do when the mother is diseased, the fœtal circulation soon suffers. The altered tissue of the decidua is unfitted for osmosis, the blood brought to it is poor, and so the circulation of the embryo suffers secondarily. In this case, which, it may be presumed, is seen in syphilized women, abortion occurs at an earlier period than is generally the case when the cause is embryonic.

2. *The Relation to Hemorrhage.*—In many cases the affection proceeds with unequal rapidity in different portions of the placenta. The affected portions differ from normal placenta in consistency; they are no longer spongy and yielding, but more or less solid, and the vascular connections with the uterus have become partially weakened. Hence, under the peristaltic movements of the uterus, the diseased portions of the placenta failing to keep in uniform relation, the weakened vascular connections break, and, the severance extending to the healthier vessels, hemorrhage follows, and commonly abortion results.

In some cases, however, where the affection is more general, the circulation may be so far arrested before the placenta is cast that, when expulsion occurs, there may be very little hemorrhage. The placenta then falls like an etiolated leaf from a tree.

Fatty degeneration of the placenta may explain some cases of hemorrhage during gestation which are attributed to placenta prævia.

"It has long been discussed," says Ercolani, "whether the alterations of the placenta were the effect or the cause of the death and destruction of the embryo. Most moderns concur in holding that these alterations are the cause of the death of the fœtus, but some seek to honor the dictum of Aristotle that the death of the fœtus is the cause of the alterations in its involucra and placenta." In some cases undoubtedly, clinical observation does not avail to determine if the disease had begun in the fœtus or in the placenta. On the other hand, numerous cases establish the fact that most of the diseases described may arise and make some progress during the life of the fœtus. This fact it is that invests the study with so much interest, physiological and pathological.

The consensus of opinion in favor of Robert Barnes's proposition, much contested at the time of its enunciation, that fatty degeneration is a cause of hemorrhage and apoplexy, seems conclusive. Bailly does not admit that apoplexy occurs in healthy tissue. Robin says apoplexy is the necessary consequence of fatty degeneration. His view is adopted by Charpentier. Ercolani distinctly recognizes it. He says the pathological cause of hemorrhages which had hitherto escaped observation is the fatty degeneration of the cells of the serotina. This, he says explains the frequency of abortion

by hemorrhage in the early months. Ercolani points out that Robert Barnes was the first to describe this change.[1]

The *etiology* of fatty degeneration. One hypothesis, advocated by Druitt,[2] is that the process is a normal one preparatory to the detachment of the placenta at labor. This may be called a physiological heresy. If, as we have seen, the constant effect of the change were to destroy the functional capacity of the tissues affected, the fœtus could not live. And in proportion as the term of gestation advances, the fœtus, growing at an accelerated rate, requires more and more blood and more placenta. The facts are, as stated in Robert Barnes's first "Memoir," that a slight degree of granular change is seen in every placenta, but in no such degree as can by any stretch of theory be considered favorable to detachment.

The part in which the normal fatty change is most common is round the margin of the placenta. The atrophy of the superfluous villi on that part of the chorion not wanted for placenta is effected by fatty degeneration.

The separation of the placenta is an abrupt violent mechanical process.

We believe that the fatty villi around the margin of the placenta observed by Druitt are chiefly degeneration of those villi which could not continue in proper relation with the decidua, and therefore become atrophied like the villi which grow at a distance from the placenta.

The Inflammatory Hypothesis.—This is probably true of a certain number of cases, but it has not been clearly proved. Ercolani maintains that it is nothing but a hyperplasia of the cellular element of the parenchyma of the villi, which may be simple or complicated with fibroma of the glandular organ (serotina). That hyperplasia enters as an important factor in many cases we have no doubt. But the change demonstrably affects the fœtal vessels as well as their chorionic investment, and in some cases begins in the coats of these vessels.

A frequent cause is: (1) Original defective vital force of the embryo; (2) another is defective nutritive value of the mother's blood; (3) a third cause may be a compound of faults of the blood and tissues of mother and child.

Cystic degeneration of the chorion; myxoma (Virchow).

Hydatidiform Degeneration of the Placenta. *Vesicular mole* (*Blasenmole, Traubenmole*, Germ.: ὑδατίς, -ίδος, a watery vesicle, Galen). This, of all the diseases to which the placenta is liable, is most obviously chorionic. It is not a very frequent disease, but there is no other disease the general appearance of which is so familiar. Specimens are found in most museums. When advanced there is no overlooking it. In its incipient stages, in some cases of very early abortion, we have, however, known it to escape detection, until the chorion was examined with a lens or a low power

[1] "Ad ogni modo credo che Barnes (1853) e Robin (1854) fossero i primi a fare speciale parola di questa lesione patologica, che indicarono, come ho detto, coi nomi di alterazione grassosa o di degenerazione fibro-grassosa della placenta." This statement is necessary in vindication of priority. Dr. More Madden, in article "Diseases of the Placenta," in Quain's Dictionary, 1882, has the following passage: "The late Sir James Simpson, Virchow, and Dr. Druitt, as well as some earlier writers, have discussed the nature of this affection, on which more light has since been thrown by Dr. Barnes's papers in the 34th and 36th vols. of the Medico-Chirur. Transactions." The facts are that Barnes's Memoirs were published in 1851 and 1853, that Simpson referred to the subject in a very imperfect manner in 1856, and that Druitt avowedly followed the researches of Barnes, his Memoir being read at the Medico-Chirurgical Society in 1853. Dr. Madden has cordially admitted to us that he had fallen into error. But the Dictionary continues to be issued without correction; hence the call for this vindication.

[2] Med.-Chir. Trans., 1853.

of the microscope. The names "vesicular mole" and "*Blasenmole*" describe sufficiently the appearance presented to the naked eye. This is represented in Fig. 109. A study of this figure will dispose of one error frequently associated—namely, that the hydatidiform mole is constructed on the pattern of a bunch of grapes. The difference is this: the grape-bunch consists of a central stalk giving off rami and twigs, each of which bears a simple berry; the mole consists of a membrane or bladder for basis, the chorion, from the surface of which a new generation of cysts is formed, each one of which has the property of developing one or more daughter-cysts. Berry grows out of

FIG. 109.

BRANCH OF HYDATIGINOUS PLACENTA AS SEEN BY NAKED EYE. (ERCOLANI.)

a. Chorion. *b*, *b*. Trunks and branches of villi. *c*, *c*. Hydatiginous vesicles. *d*, *d*. Branches of vesicles.

berry, and the stalks do not unite berries with principal stems, but berries with berries, and lastly with a central mother-cyst. The nearest similitude is found in the growth of the cactus or prickly-pear, in which plants, from each leaf or stalk, new stalks bud out, which in their turn give off other stalks. It is a process of germination or continuous budding. The German name "Traubenmole" should therefore be discarded.

We may here dispose of another error suggested by the name "hydatid mole," sometimes used. It was at one time considered that the vesicles were

true hydatids; and it is related that Percy (1811), believing in this, chivrously defended the chastity of two women who were delivered of hyda moles. He saw in the vesicles signs of life. No one since his time h

FIG. 110.

TERMINAL EXTREMITY OF A HYPERTROPHIC CHORION-VILLUS. (ERCOLANI.)
d, d. Epithelial neoplasms springing from surface of villus.

witnessed this, so that his cases remain in their isolation appealing to credulity.

It is nevertheless true that real hydatids may make their way into and through the uterine wall. No tissue in the body is absolutely secure against their attack. Braxton Hicks and Hewitt relate examples.

FIG. 111.

BUDDING GROWTH OF CHORION-VILLI.
a. Chorion-investment of villus. *a'.* Villus chorion peeled off. *b.* Budding of villus.

To form a clear conception of the origin and nature of this disease, we must return to the structure and development of the young chorion-villi. These grow or increase by bud-like processes (see Fig. 111)—pyriform,

clavate, or fusiform, the narrow part connecting them like a stalk with the end or side of the villus; or sometimes the extremity of a villus appears enlarged, and divided into a number of lobes, no contraction of a part resembling a stalk; sometimes the processes have a vesicular appearance, and still there is no disease. In perhaps the earliest ovum (lent us by Dr. Sharpey) which we have had an opportunity of examining—probably not four weeks old—the termination of every villus exhibited a simple or compound lobular appearance, or distinct projection; and some villi had processes from their sides. At a later stage of growth, instead of the clavate or fusiform processes, there are seen cylinders of greater or less length, but still bearing a resemblance to the primitive shape in the dilated extremities. These are young villi. Often upon these, again, secondary processes, or buds, may be observed. Inasmuch as the rapid growth of the fœtus towards the term of gestation is ever calling for increased expansion of placenta, fresh villi are constantly forming. These buds are accordingly seen on the villi of placentas approaching maturity; but they are far less frequent than in early ova.

Now it appears that under the influences of a perverted developmental force, these buds, instead of growing into villi, carrying bloodvessels, may dilate into true vesicles or hydatidiform cysts. Such a perverted growth necessarily involves the destruction of the placenta as a respiratory organ, and the consequent death of the embryo. Having examined a great number of ova of different epochs, we have become familiar with various appearances which can neither be referred to healthy villi nor to hydatidiform degeneration. We have noted bodies attached to villi which, although evidently of the same origin as the ordinary budding villi, were yet so different in some of their characters as clearly to have failed as villi, and which, nevertheless, were not recognized as hydatidiform cysts. We are disposed to regard these as marking an intermediate stage or transition into cystic degeneration.[1]

The more advanced stage is thus described by Paget: "Certain of the proper villi of the chorion deviating from their cell-form, and increasing disproportionately in size, form cysts which remain connected by the gradually elongated and hypertrophied tissue of the villi. On the outer surface of the new-formed cysts, each of which would, as it were, repeat the chorion and surpass its powers, a new vegetation of villi sprouts out of the same structure as the proper villi of the chorion. In this begins again a similar development of cysts, and so on *ad infinitum*. Each cyst, as it enlarges, seems to lead to the wasting of the cells around it; and then moving away from the villus in which it was formed, it draws out the base of the villus, which strengthens itself, and forms the pedicle on which the cyst remains suspended." The disease presents a curious example of a structure endowed with independent formative force continuing to grow—a pure parasite—for itself alone, having ousted the original parasite, the embryo.

The cystic degeneration generally attacks all the chorion-villi, including those not destined to form placenta. Michael describes a case in which a patch of cystic chorion-villi[2] grew at a distance from placenta, which itself was healthy.

In many cases the diseased villi send processes far into the wall of the uterus, the cystic growth extending along the maternal tissues. This might be expected since the normal villi shoot into these sinuses (see Fig. 112). The difference is, that along with the cysts there penetrates neoplastic matter, and the growth is more active, leading in some cases to strong, even

[1] On the Diseases of the Placenta, Brit. and Foreign Med.-Chir. Review, 1854–5–6.
[2] Beale's Archives, No. IV.

inseparable union. R. Cory gives a most interesting example, in which cystic villi penetrated deeply not alone into the interior wall, but also into a polypoid fibroma projecting into the cavity of the uterus. The patient died of hemorrhage. A similar case[1] is recorded by R. Barnes; a fibroid tumor also coexisted. This patient also died.

Two conditions are constantly found in connection with this cystic degeneration: hypertrophy of the decidua as well as of the chorionic tissue, and fatty degeneration. Ercolani says there is a remarkable neoplasm of the epithelium of the chorion-villi. Wedl and Robin described the affection as a dropsy of the villi, but this view Ercolani denies. He also denies Virchow's theory adopted by Hennig, that it consists in a myxoma of the villi. It must, however, be admitted, that tissue in all respects resembling myxoma is constantly found in the mucous tissue between the central vessel and the

FIG. 112.

PENETRATION OF CHORION-VILLI INTO UTERINE SINUSES. (SCHROEDER VAN DER KOLK.)

a. Vessel. *b*. Villi in uterine sinus.

epithelium of the villus. Virchow and H. Müller attribute the origin of the hydatidiform change in the villi to this morbid thickening of the decidua, thus assigning a maternal cause.

The *causes* of hydatidiform degeneration are obscure. It occurs in young and apparently healthy women. We have known several instances of women bearing one or more healthy children at term, then a hydatid mole, to be followed by healthy pregnancies, and this to the same husband; and we have in some instances been able to exclude with reasonable certainty all suspicion of syphilis on either side. Nor could we, in many cases, detect evidence of other diathesis. Still it may well be that syphilis, by affecting the decidua, may now and then be a predisposing factor. In several cases there has been a complication with Bright's disease or albuminuria. Dr. Woodman narrated cases,[2] and some we ourselves observed, in which it seemed clear that the kidney disease existed before the gestation began. Looking at the coincidence of three forms of dropsy—anasarca in the mother, cystic dropsy of the placenta, and dropsy of the fœtus—it seems probable that there existed a causative relation. On the other hand, in many cases no albuminuria has been detected; and in some cases it is certain that albuminuria arises under the influence of the mole-pregnancy, as it does in normal pregnancy.

Dr. Hugh Thomas relates[3] a case in which a hydatidiform mass, weighing

[1] Obstetr. Trans., vol. xx. [2] Obst. Trans. [3] Brit. Med. Journ., 1883.

3¾ lbs., was removed from the uterus. Complicating jaundice disappeared when the uterus was emptied.

Two theories in this connection have to be discussed, on account of their clinical and medico-legal relations. The one is, that the cystic change starts from the death of the embryo; the other is, that the change may start in a portion of the placenta left adherent to the uterus after an ordinary labor. These two theories have, to some extent, a common basis. Both postulate that the change is independent of the embryo. If we arrive at a definite opinion upon the validity of either of these theories, we shall have gone far to solve both. Let us first examine the evidence in support of the theory that the disease follows upon the death of the embryo. The theory is supported by Mikschik and Graily Hewitt.

Presumptive evidence in favor is drawn from the general rule that where hydatidiform degeneration is extensive, no embryo can be found. But it must not be assumed that this is universal. There is a specimen in St. Thomas's Museum showing a four months' embryo with hydatidiform placenta; the amnion is apparently healthy.

In opposition to this argument, moreover, there are well-authenticated cases of living children having been born in association with vesicular disease of the placenta. Thus Perfect relates that he was called to a case with excessive discharge of waters, and lingering labor. The child large, lived. The mother got up in ten days. The placenta, he says, had a particularity "which I never before or since remember to have observed, for part of its external surface was vascular and divided into small lobes, and the other part of a jelly-like substance spread with vesicles filled with water." The woman informed Perfect that from the second month of her being with child to the time of her labor she had frequently discharges of water coming away involuntarily.

Villers[1] relates that a woman first passed hydatids, then a fœtus 10 inches long and of more than five months' development. Its heart-beat was faintly heard shortly before delivery. The umbilical cord ended in a few loose threads, which sank in the midst of a mass of hydatids. A flap of membrane adhered so tightly to the uterus that he had to leave it behind. The woman died of metritis.

E. Martin, of Berlin,[2] relates three cases. In case 1, abortion occurred at the end of the third month; an embryo was found answering to this date; the chorion-villi were affected with hydatidiform degeneration. In case 2 labor set in at the eighth month with hemorrhage; the child was living; many parts of the placenta showed large vesicles filled with clear fluid on the outer surface, with spaces of healthy placenta. Case 3 was similar. Bleeding preceded labor at the end of the eighth month; child dead-born; vesicles of various sizes were found in the placenta.

Krieger tells an instructive history in point.[3] A woman was delivered prematurely of a child, which died immediately. The placenta was in hydatidiform degeneration, excepting a piece the size of a dollar. The fœtus was dropsical, its kidneys very large; the mother was also œdematous towards the end of gestation, urine not albuminous. In her next pregnancy she bore a child also premature and dropsical; a large portion of the placenta was hydatidiform, but the greater half normal; the child quickly died; the mother was œdematous. In her third pregnancy she was again œdematous; labor was induced; the child, born also quickly, died dropsical; there were some bladders on the border of the placenta, the rest was healthy.

[1] Schmidt's Jahrb., Band 39.
[2] Monatsschr. f. Geburtsk., Band xxix.
[3] Monatsschr. f. Geburtsk., 1864.

The cognate theory that ordinary placenta left *in utero* may undergo cystic degeneration is more difficult to disprove; and, it may be added, not less difficult to prove. How do we know, for example, that the cystic disease observed in a given placenta began after the death of the embryo? It is convenient to state a case as it is presented in practice. A woman is delivered of a child at term. After the lapse of three months or more a vesicular mole is discharged. There is evidence more or less satisfactory that the whole of the after-birth did not come away at the labor; and it is inferred that the portion then left underwent the cystic change. Perhaps the husband was absent; the question of chastity arises. Is the theory of cystic conversion of retained placenta to be adopted, or must we conclude that the mole is the product of a new conception? Ruysch, Burns, Ramsbotham, and Murphy affirmed the occasional occurrence of this *post-partum* conversion. Morgagni, most sagacious of pathologists, concluded that wherever the change is observed it began before the expulsion of the child. Our own observations lead us to adopt Morgagni's opinion.

1. The cases of live children in connection with cystic placenta prove that the death of the embryo is not a necessary factor. 2. The history of cases proves that the disease in many cases begins early and proceeds rapidly to the development of large moles. 3. We have demonstrated the existence of the disease in ova not exceeding six weeks old. 4. There is this remarkable circumstance: the cystic formation is almost invariably found developed over the entire superficies of the ovum. The significance of this is clear. The change began so early as to attack the whole system of shaggy villi covering the chorion, preventing the atrophy of part which takes place in normal course when the placenta proceeds to concentration in a limited area. There is no concentration of villi or vessels towards an umbilical cord in those cases in which no embryo is found. The inference is that the early disorganization of the chorion-villi killed the embryo whilst yet minute and soft, so that it easily disappears by fatty liquefaction. We have seen this in process. The absence of embryo in most cases is thus accounted for. If the change proceeds less rapidly, as it does in exceptional cases, the embryo may survive and grow, and under the stimulus of its growth may maintain or produce a sufficient amount of working placenta.

We think, therefore, that the hypothesis of conversion of mature placenta must be rejected. Still there is a plausible explanation of the case we have stated consistent with the woman's chastity. It is found in the history of twin-gestations. One ovum may proceed to normal development, the other may pass into cystic degeneration, its embryo being destroyed. The healthy ovum, child, and placenta, may be born and the cystic ovum may be retained for awhile. The retention of the mole after the expulsion of the healthy placenta may be accounted for by the known intimacy of growth of the cystic mole to the uterus by penetration into its walls. Where this explanation cannot be applied, we are thrown back upon the conclusions, either that the cystic change began before the expulsion of the child, or that it is the product of a conception subsequent to the labor.

Hall Davis relates a case[1] of twin-conception in which one child was found connected with a normal placenta, and the other ovum was converted into a vesicular mole, without an embryo. Hildebrandt[2] relates a case in which one ovum fell into hydatidiform degeneration, whilst a twin ovum did not, but contained a fœtus very dropsical.

Montgomery cites the following historical case. A lady four or five months pregnant expelled a quantity of hydatids, and subsequently, at the proper

[1] Obst. Trans. [2] Mons. f. Geburtsk., 1861.

time, gave birth to a living child, who developed into the celebrated Béclard. Is it not possible that in this case there was a twin conception, one ovum falling into degeneration and being expelled, whilst the other, healthy, went through normal development? This conjecture is strengthened by Ingleby's case. "A woman after long-continued hemorrhage passed a diseased placenta of the hydatidiform appearance, but without any apparent fœtus; the os uteri closed, and to the surprise of all parties, the patient was delivered a few weeks afterwards of a mature child and secundines."

The Clinical Evolution of Hydatidiform Degeneration of the Placenta.—At the beginning the course of the gestation is hardly to be distinguished from that of an ordinary gestation. As it goes on, close observation may discover that the rate of evolution of the uterus and abdomen differs from the normal. The size of the uterus, for example, does not tally with that which would be expected on calculation. Presently, perhaps at the end of two or three months, discharges of blood, or water tinged with blood, occur. If minutely examined, vesicles may sometimes be found floating in the discharges. Abortion may occur within a few weeks; the ovum may pass in a mass; and unless examined by lens or microscope, the vesicular change may escape detection. We believe this event is not uncommon. In other cases, water and blood discharges recur; the abdomen and uterus enlarge, but not with the regular progression of normal gestation. At last, suddenly in some cases, profuse hemorrhage sets in with pain, and the mole may be expelled compressed into the shape of the uterine cavity, and presenting a solid mass made up of hyperplastic decidua, infiltrated with blood, and the chorion degenerated into vesicles. Moles in this state differ in appearance from the specimens in museums. In these latter, the chorion-villi and cysts are floated out. In some recent moles, all the parts are compressed into a mass, and the vesicles may not be detected until specially sought for. But generally some may be seen cropping up on the surface. On cutting into the mass, a cavity is opened lined with a smooth serous membrane, the amnion.

In other cases the mass loses cohesion even in the uterus; the decidual connective tissue has broken up under fatty degeneration, the diseased villi fall apart, portions break off and are expelled with blood and water, likened not inaptly to red currant juice with vesicles swimming in it. Discharges of this kind recur at uncertain intervals, with pain, the bulk of the uterus varying in size. At length, under the usual signs of labor, the remains of the mole are expelled. When the disease has gone on for several months, the quantity of fluid and vesicular masses discharged may be very great, amounting to three or four quarts or more. In some cases, all the mole is not expelled, but hemorrhages go on, resisting ergot, expression, and calling for removal by the hand. The patient may sink under the loss of blood; but the uterus fairly emptied, the subsequent course of things resembles that of normal labor—the uterus contracts, undergoes involution, and the breasts secrete milk.

The woman is exposed in an unusual degree to the accidents of puerpery. Metritis, perimetritis, thrombosis, phlegmasia dolens, septicæmia, may set in; and these complications are especially probable in those cases in which the detachment of the diseased chorion is imperfect, owing to villi penetrating the uterine sinuses and thus growing into the uterine wall.

Recurrence of the Disease.—In some cases the disease recurs. Thus it recurred three times in Krieger's patient. Mr. Osborn relates (1865) a most interesting case of a young woman, apparently healthy, who in four successive pregnancies was delivered of a vesicular mole. It is remarkable

that her first two pregnancies were due to one man, and the next two to another man. This history favors the hypothesis that the cause is not primarily embryonic.

TREATMENT.—The treatment falls within the general rules relating to abortion. As soon as we get distinct evidence of vesicular formation, hemorrhages and watery discharges occurring, the conclusion is justifiable that abortion must take place. If on examination the cervix is found open, it will generally be desirable to remove the ovum by the finger. Under chloroform, this operation can generally be carried out. But in those cases in which the diseased chorion sends off shoots into the walls of the uterus, complete detachment even by the hand is not always possible. Ramsbotham, Robert Barnes, and Waldeyer relate cases of this kind in which no line of demarcation between placenta and uterus could be felt. In one of Robert Barnes's cases the wall of the uterus was softened, more brittle, so that it was difficult to avoid lacerating it. The patient recovered.

The greatest care is necessary in these cases. It should be accepted as a rule to detach so much as will come away with reasonable force, and to leave the rest. It is better to encounter the possible reproach that "a bit of the afterbirth was left behind," than to risk lacerating the uterus. A second or third attempt may be made after a day or two to bring away what was left. And under the ecbolic action of ergot, quinia, and digitalis, the uterine muscle contracting may compress the intruded vesicles, and they will disappear by fatty metamorphosis and absorption, or with the lochia. It will generally be useful to paint the inside of the uterus with tincture of iodine and glycerine (1 in 5) once a week for a few weeks afterwards.

Is there a Prophylactic Treatment?—We know at present of no rational basis for such treatment. Where the disease has once occurred, the general indication is to promote in every way the health, local and constitutional, of the subject. Reflecting that in many cases, at least, hyperplasia of the decidua enters as a factor, the mucous membrane of the uterus may be usefully painted with iodine, carbolic acid, and glycerine.

Moles.—The term is generally employed to signify solid substances expelled from the uterus. Substances more or less solid are cast out under symptoms resembling those of true abortion. It becomes important to determine whether or no a given mass so expelled be the product of conception—that is, whether the process be one of true abortion.

The substances included under the general term of moles are: 1, *blood-clots*, still retaining all the elements of blood, except a part of its serum; 2, *fibrin-clots*, the serum, globules, and coloring-matter being in great part expressed (these are sometimes called fleshy moles); 3, *decidual tissue* thickened with condensed blood; 4, *an early ovum*, the decidua greatly thickened by infiltrated blood; 5, *a more advanced ovum*, the chorion and decidua both consolidated by condensed blood; 6, *the hydatidiform or vesicular mole;* and, 7, *a fibroid polypus or tumor.*

To these we must add the "fibrinous polypus" and the "placental polypus," mostly observed after ordinary abortion or labor.

The first point to establish is the presence or absence of ovular structures.

1 and 2. Blood- or fibrin-clots sometimes present thin glistening membrane, suggesting amnion. But this is not enough to prove that the mole is of embryonic origin. On teasing the clot, we find nothing but blood constituents and fibrin in a state of fibrillation.

3. Decidual tissue, again, may, with or without blood, be compacted into a mass, or free as shreds. But unless we detect by the microscope chorionvilli, the mole must be regarded as exclusively of uterine origin.

. Ova, early or advanced, are identified by two distinctive charac-
presence of chorion-villi, and a cavity lined by a smooth serous
—the amniotic sac. Generally, also, there is the embryo; but in
and the vesicular moles no embryo may be found.
hydatidiform mole is recognized by the vesicular structure.
fibroid polypus is distinguished by its solidity, by its texture, and
sence of chorion-villi. We have been summoned to attend the
colleague for abortion. What was considered to be the ovum had
This substance was as large as a hen's egg. It was a fibrous poly-
d the lady been single, or not living with her husband, her chastity
e been impeached. There was the apparent *pièce de conviction.*

CHAPTER XV.

LABOR.

THE PROCESS OF PARTURITION: EXTRUSION OF THE FŒTUS; EXTRUSION OF THE PLACENTA.

LABORS are divided into—1. Spontaneous; 2. Artificial. Other divisions are stated: we think this is the most simple and comprehensive, but subdivisions are necessary.

1. SPONTANEOUS LABORS are those which are terminated by the natural forces. They are *easy* or *propitious*, falling under the head of *Eutocia*—εὖ, well, τόκος, a labor; or laborious and difficult, falling under *Dystocia*—δύσ, bad, τόκος, labor.

2. ARTIFICIAL LABORS are those in which recourse is had to art. The artificial labors thus all fall under the head of Dystocia.

Again, labors may take place *at term*—that is, at the end of ten lunar months; or *prematurely*—that is, at any time after the fœtus has attained viability. In the latter case the labor may be either spontaneous or artificial.

WHAT IS THE NATURAL TERM OF GESTATION? This question has been discussed rather than decided when studying the question of the Duration of Gestation.

What is the Cause of Labor?

A problem full of interest: many solutions, each perhaps containing a part of the truth, have been put forth. We might ask the cognate question: Why does the ripe apple fall to the ground? It looks like begging the question to answer: It falls because it is ripe. The explanation of many of the phenomena of Nature is scarcely more satisfactory. We may trace more or less completely the sequence of natural phenomena without being able to fathom final causes. Labor may be regarded as an ultimate fact, the expression of a law, some of the moving factors of which are unknown to us. We may, however, usefully state what is known or reasonably conjectured.

The *causes of labor* are *efficient* and *determining*.

The Efficient Causes.—It was at one time thought that, like the escape of a bird from its shell, the exit of the child from its mother's womb was partly effected by its own exertions. It is only necessary to recall the fact that a dead child may be expelled from the womb. That life in the child favors easy labor, and that a dead child may impede labor, is true. When the child is living, its movements excite the healthy action of the uterus, and the uterus responds more readily to the natural excitation, because it and the nervous and vascular systems are in the fulness of physiological tension and activity. On the other hand, when the fœtus has been dead some time, the nervous and vascular supply in the uterus and the centric irritability are diminished, and the inert mass of the fœtus is incapable of giving the healthy stimulus to contraction. The loss of tonicity of the fœtus permits it to be rolled up into a ball, so that the pressure is not brought to bear effectively upon the two points of chief irritability, the fundus and the cervix. Thus,

a dead fœtus may be a cause of dystocia; but it does not follow that a live child is an efficient cause of labor.

The real *efficient causes of labor* are—1. The contractions of the uterus; 2. The contractions of the abdominal muscles.

Now what are *the determining causes:* those which provoke the uterus to contract to expel its contents?

A. Causes Proceeding from the Fœtus.—Towards the end of gestation its movements are more active, and then act upon an organ whose irritability is intensified. The fœtus has a share in the provocation of labor.

B. Causes Proceeding from Modifications of the Ovum.—Druitt, J. Y. Simpson, Schrœder, and others, contended that towards term a partial detachment of the ovum took place as the consequence of fatty degeneration of the decidual element of the membranes. We cannot assent to this, because we doubt the fact of the precedent detachment, and the postulated fatty degeneration. This subject has been discussed under the Diseases of the Placenta. In this view we are supported by Langhans, Dohrn, de Sinéty, and Leopold. This last author, however, advances a new hypothesis.[1] He says the decidua reflexa and the serotina, and even the decidua vera, become thinner and thinner towards the end of gestation. He confirms Friedländer in the proposition that there is a constant and normal spontaneous formation at the end of gestation of venous thromboses in the muscular wall of the uterus near the serotina and in the serotina itself. These thromboses obstruct the veins affected; hence collateral hyperæmia and stasis of the maternal blood returning from the placenta. Leopold then asks if this is not one of the causes of labor, since Brown-Séquard showed that the irritability of the uterus increases constantly with the advance of pregnancy, so that at last the presence of carbonic acid, a strong excitant of contraction, in the maternal blood would suffice to provoke labor.

C. Determining Causes Proceeding from the Maternal Organism.—Scanzoni affirms that from the eighth month the uterus is developed by distention, and no longer by hypertrophy. This stretching would in the end so irritate the organ, that it would contract upon the ovum to expel it. He agrees with Tyler-Smith, who argued that ovarian nisus at the tenth month determined an increased afflux of blood to the uterus, and thus provoked labor.

Brown-Séquard insisted upon the great increase of development of the venous system towards the end of gestation, thus bringing a larger volume of carbonic acid into contact with the irritable muscle.

Recent observations upon the behavior of the neck of the uterus in gestation, to which we have already referred (see vol. i., chap. vii.), suggest another theory. We have seen (1) that the neck of the uterus softens, from below upwards; (2) that painless contractions of the uterus are going on throughout gestation; and (3) that during the last fortnight of gestation the softening of the cervix having invaded the whole structure, the os internum opens to increase the capacity of the uterus. Now it is argued that so long as the softening is limited to the lower part of the cervix, the draggings of the uterine muscle have no effect in opening the inner os, and thus of bringing the ovum into contact with the lower part of the cervix; but that when the softening has invaded the whole cervix, then the uterine contractions act effectively, open the os internum, and thus bring the ovum into contact with the lower zone of the cervical canal. This provokes active contraction, and labor is determined. This is the view taken by Stolz and Bandl. It recalls the hypothesis set forth by Power (1819), and since taken up by Dubois and

[1] Die Uterusschleimhaut während der Schwangerschaft, etc.

Depaul. These authors contend for complete analogy between the expulsion of the product of conception and the excretion of urine and feces. The structure may be compared to that of the bladder and rectum. All, in fact, are composed of a dilatable reservoir, and an irritable sphincter composed of circular fibres. When the contents of the cavity come to press upon the sphincter, reflex contractions are excited. But the direct irritation of the sphincter is not enough to bring these contractions into play. The distention of the reservoir itself and the resulting dragging of the muscular fibres concur in producing them.

It appears to us that the arguments advanced by Tyler-Smith are too strong to be set aside. The great law of Periodicity which rules menstruation is never suspended. We have already compared menstruation with labor. Regarding labor as the equivalent of menstruation, or its substitute, we should naturally expect it to take place at what would be a menstrual epoch. Calculation proves this to be true in a great number of instances. We see the same periodical ovarian influence at work in determining abortion and premature labor.

We should then sum up the determining causes of labor in a group of factors acting synergetically, or in necessary connection of sequence, as follows: Maturity of the ovum; changes going on in the placental tissues; thrombosis in the muscular wall of the uterus; accumulation of carbonic acid in the blood supplying the uterus; softening of the cervix, ending in pressure of the ovum upon the lower segment of the uterus and cervix; growth of muscular tissues of the uterus and increase of uterine and centric irritability; stretching of the uterine muscle; and lastly, ovarian irritation, which, returning at the epoch of highest tension, causes the final explosion of nervous force, the effect of which is labor.

There are Three Factors in Labor: 1. The body to be expelled; 2. The expelling force; 3. The resisting force. A. R. Simpson describes these alliteratively as—1. The passenger; 2. The power; 3. The passages.

The Process of Parturition.

The term of gestation completed, certain phenomena announce the advent of labor. In many women labor sets in suddenly. In others, perhaps the greatest number, especially of primiparæ, certain *precursory or premonitory signs*, subjective, and objective, are observed: 1. The first in order of these is the sinking of the fundus of the uterus, which takes place from eight to fifteen days before labor. Upon this, some women experience great, almost sudden relief: digestion is more easy, breathing is freer, movements are brisker. Others are differently affected: they are less disposed to exertion, and feel a sense of weight in the lower abdomen, on the rectum and bladder, attended by tenesmus, diarrhœa, and frequent micturition; 2. The venous circulation of the lower limbs and genitals is more embarrassed; the vulva swells. 3. Slimy discharge, yellowish or white, flows from the vagina. This mucus is sometimes streaked with blood, due to the detachment of the caduca or chorion from the lower segment of the uterus. This appearance, or "*show*," as it is called, is a common indication of labor being at hand. 4. At the same time, the latent contractions, which have attended the whole course of gestation, become more frequent, stronger, and the woman experiences a sense of constriction, of tightening in the lower abdomen and loins. These constrictions sometimes become painful several days before labor. Premonitory pains may come on in paroxysms, lasting an hour or more, exciting false alarms and untimely calls upon the doctor.

At last parturition declares itself, and we observe *a series of physiological phenomena*. These are *five*. (1) The contractions of the uterus and abdominal muscles; (2) the dilatation of the os uteri; (3) the formation of the bag of membranes and its rupture; (4) the escape of blood-streaked mucus; (5) the dilatation of the vagina, perineum, and vulva. These phenomena do not occur in an isolated manner. They form two groups, which answer to two distinct periods of labor. The *first period* begins with labor and lasts until the os uteri is fully dilated; this is *the period of dilatation*. The *second period* begins at the end of the first and ends with the extrusion of the fœtus; this is *the period of expulsion*. The *third period* is marked by the extrusion of the placenta; this is the *placental period*.

The Uterine Contractions.—During gestation the contractions are feeble and painless. They become energetic and painful at the time of labor. Contraction is a strictly physiological act, and is not normally attended by pain. *Pain is the consequence and expression of resistance.* As in defecation and micturition, if the expulsive effort and the resistance are accurately adjusted, and if the structures of the contracting organ and of the sphincteric orifices are healthy, the function is performed without pain. In some typical women labor is actually carried through without pain. Some describe the process as no worse than ordinary defecation; others have actually been delivered during sleep.

It is important to bear this in mind, for although pain is the ordinary lot, and is often an important physiological factor, as Marshall Hall and Tyler-Smith explained, it is in its essence pathological. And in this fact lies the justification of the use of anæsthetics. It is by a metonym, then, that, confounding cause and effect, we speak "*of pains*" when we mean expulsive contractions. Pain depends mainly upon two conditions—First, the susceptibility of the subject; secondly, the state of the expelling and resisting structures. If these structures are hyperæmic, inflamed, the seat of morbid action or deposit, or are unusually rigid, then pain is proportionally developed.

The contraction is revealed by other signs than by the subjective one of pain. When the contraction occurs, if we place the hand upon the anterior surface of the abdomen, the uterus is felt to harden. This hardening is felt some time before the pain declares itself, and often one may thus announce to the woman that a pain is coming on before she is conscious of it; and when the sense of pain has gone, the uterus still remains hard for a little while. Again, we realize the existence of contraction by vaginal touch; thus we find that the os uteri is more rigid during the contraction; that at the moment of contraction the bag of waters is distended and starts through the os; and if the membranes are ruptured, there flows at the commencement of the contraction a small quantity of liquor amnii.

Under the influence of the contraction *the uterus changes situation and shape*. Usually inclined to the right, it comes nearer to the median line, whilst the fundus and anterior wall are carried forward against the abdominal wall, which is raised up by it. When the abdominal muscles come into play, the fundus uteri is carried back against the spine. This result has been directly verified on mammifera by vivisection; it is due partly to the contraction of the broad ligaments, and especially of the round ligaments. The muscularity of these ligaments, demonstrated by Rainey, has been proved to increase at the menstrual epochs and during gestation.

The *shape* of the uterus is changed. Under concentric contraction it would become spherical but for the resistance of the fœtal ovoid. Thus, when the fœtus loses its resistance under decomposition, it becomes compressed into a ball under the uterine contractions, and the uterus is spherical. But under normal conditions the form assumed is cylindrical. The antero-

posterior diameter is elongated, the transverse diameter is contracted; longitudinal diameter ought to be lessened also, but by virtue of a fo which Schatz calls *the force of restitution of form*, it elongates. In fact, uterine pressure, determined by the contraction, causes the fœtus, curved its anterior plane, to straighten itself, and thus to increase the height of fœtal ovoid. This reacts upon the walls of the uterus; on one side it pus back the fundus of the uterus, which presents during the contraction an a corresponding to the breech of the fœtus; on the other side it rests by inferior pole,—that is, by its head—upon the lower segment of the ute At the end of labor the fœtus maintains this new erect attitude, even dur the intervals of contractions. Thus, according to Braune, at the beginn of labor the length of the uterus is about 26 cm., increasing by 6 cm., nearly 2.40 inches, beyond its length before the onset of labor and t beginning of the period of expulsion. Hence, during labor, the sha assumed by the uterus is cylindrical, not spherical.

In ordinary labor *the contractions are general*, not partial. They embra the whole organ. But they are not *ab initio* general; they invade the di ferent regions of the uterus successively—that is, *in peristaltic* order, Tyler-Smith contended, spreading from above downwards, or, in some case *anti-peristaltic*, spreading from below upwards, as Kehrer described. Th movements are rhythmical.

The uterine contractions are *involuntary*. The parturient woman canno produce them, suspend them, accelerate or retard them. *Moral emotion* however, influence them. Fear retards, confidence restores them.

An essential character of uterine contractions is their *intermittence*. The return at nearly regular intervals if observed during the like stage of labor But the intervals which separate two consecutive contractions are of ver different duration at the different stages of labor. At first the interval average about twenty minutes; during the dilatation stage they return ever ten minutes, and even towards the end every five minutes; and during th expulsive stage every two or three minutes. But there are great variations Sometimes the contractions are suspended, or accelerated, or slowed withou ascertainable cause. Sometimes it seems as if the tired uterus took rest, and then acted again with vigor. Intermittence is the general law which govern the contractions of all the muscles of the body. Like the heart, the uteru is subject to this law.

The *duration of the contraction is variable* in all the stages. Generally i is shorter at the outset than at the end. At first it lasts thirty seconds, then rises to sixty seconds, it rarely exceeds one hundred seconds.

In some abnormal cases the contractions become *continuous and tetanic*.

What is the *intensity* of the contractions? It varies at the different stages It is greater during the stage of expulsion, and at the end of the stage o dilatation, than at the beginning of this stage. As a general rule, the con tractions are stronger as the labor advances, unless they remit, in consequence of the exhaustion of the uterus. But then the labor is pathological and *uterine inertia* ensues. Intensity and frequency of contractions mostly go together. The closer the contractions follow each other, the greater is their intensity.

The contractions follow in pairs, that is, a strong contraction is followed by a feeble one. The intensity varies during the same contraction. There is a stage of increase, a stage of maximum, and a stage of decrease. The three stages of a contraction constitute the *systole*, the interval of rest the *diastole* of the uterus.

Attempts have been made to estimate in figures *the intensity of the uterine contractions, or the force required in labor*. Poppel, Matthews Duncan

Haughton, and Ribemont-Dessaignes tested this by the force required to rupture the membranes, assuming that this force represented nearly the intensity of the uterine contraction.

The experiments of Poppel made on a piece of membrane 10 centimetres in diameter gave a mean bursting pressure of 6.162 kilogrammes, those of Duncan on membrane 112 millimetres in diameter gave a mean pressure of 7.587 kilogrammes, ranging from 2 to 18 kilogrammes; those of Ribemont-Dessaignes, conducted with special care, on an orifice of 10 centimetres found the average bursting pressure to be 10.300 kilogrammes. Joulin estimated the highest contractile power of the uterus at 100 lbs.

Haughton[1] found that the involuntary or uterine force equalled 3.4 lbs. on the square inch, and that of the voluntary or abdominal force equalled 38.6 lbs. on the square inch, giving a maximum expulsive force of 42 lbs. "Calculating the fœtal head to have a diameter of 4½ inches, this would represent the enormous force of 593 lbs., or about a quarter of a ton, which *might* be engaged in parturition. He of course was aware that only a small proportion of this power was usually exerted."

Duncan thinks the maximum expulsive power of labor, including the uterine contractions, with the assistant expulsive efforts, do not exceed 80 lbs. The difference between the two estimates creates distrust in the accuracy of their experimental methods. Duncan's estimate accords best with clinical observation.

But these estimates are quite untrustworthy. They are too variable to justify any definite conclusions; the conditions of the experiments differ essentially from those obtaining in labor; the membrane is dead tissue, and thus less resisting than live tissue; it is tied to a rigid ring, whereas in nature the membrane is continuous, and is forced against a yielding and elastic ring; the force is applied by nature in recurrent impulses, which may be imagined to test the resisting power gradually, sparing the full impetus until the due moment of bursting has arrived. These different conditions vitiate experiments conducted on this plan. It is, moreover, certain that the bursting force of the membranes thus found is below the force required to expel the child, and therefore inadequately represents the expulsive energy of the uterine contractions. Speigelberg also says that all the experiments upon the resisting force of membranes are invalidated by great fallacies. The point illustrated by these experiments is simply the resisting power of a piece of dead membrane.

Schatz[2] pursued a totally different plan. He measured the expulsive force by means of an apparatus called the *tocodynamometer*. It works something like a sphygmograph. By this he estimated that pressure exerted at the end of labor, by the uterus and abdominal contractions varied from 17 to 55 pounds. It must, however, be observed that this does not represent the simple pressure of the uterus upon the membranes, but the combined pressure of all the expulsive forces.

Dr. Poullet, of Lyons, used an apparatus similar to that of Schatz,[3] called the *tocograph*, which enabled him to differentiate the uterine from the abdominal pressure.

There is a strictly clinical test by which we may confront these experimental observations and estimate their value. Thus, children weighing 5 pounds, or less, to 18 pounds, are expelled by the natural forces. The parturient lying on her side, there is no help from gravity, and friction has to be overcome. This last factor, no doubt varies, but it is in many cases

[1] Dub. Med. Press, 1870.
[2] Beiträge zur physiologischen Geburtsk. (Archiv für Gynäkologie, 1873).
[3] Tarnier et Chantreuil.

considerable, and it gives an unknown quantity to be added to the child's weight. We may safely assume that Schatz's estimate is not exaggerated. The range is accounted for by the variable factors of weight and friction. The expulsive force is regulated by the resisting factors. *Nil natura frustra facit* holds here. The force adapts itself to the resistance. It rarely is in excess, it more often falls short, and then we have lingering labor that has to be helped by artificial force applied *à fronte* or *à tergo*.

We may formulate this law: *The propelling or driving force in labor is the measure of the resisting forces.*

The *character of the pains* differs in the different periods of labor. During dilatation the pains are irritating, depressing. The woman seems to suffer without making progress. In the period of expulsion, the pains are more acute, but they are better borne; they give the sense of stretching, and even of tearing. Very painful, indeed, but they are attended by a consciousness of progress; "they do good." The woman bears them with courage, and is cheerful in the intervals. Sometimes the relief obtained on the cessation of the pain is so complete that the patient falls asleep until the next pain awakens her.

The *seat to which the pain is referred* varies. During dilatation they are often felt in the sides of the uterus or in the loins; later they radiate around towards the pelvic region and the lower segment of the uterus. To escape them the woman often changes her posture, flexing the trunk upon the pelvis and thighs, so that the fœtus may bear less directly upon the os uteri. Depaul says *lumbar and sacral pains* are chiefly observed when the presenting part is kept at a distance from the orifice, as from pelvic deformity or presentation of shoulder or face.

Pains are sometimes felt which are called "*false pains*," in order to distinguish them from the *true or efficient pains of labor*. False pains have variable seats; sometimes in the abdominal walls, sometimes in the intestines, associated with dyspepsia, diarrhœa, or retention of feces or of urine. In these cases the uterus does not contract; or if there be some reflex contraction it is partial, and produces no effect upon the os uteri. These were called by Power "metastatic pains." The nervous energy is diverted from its proper use.

Uterine Contractions and Pain affect the Fœtal and the Maternal Circulations. EFFECT UPON THE FŒTAL CIRCULATION.—If the stethoscope be applied during a pain the fœtal heart-beats are observed to become slower. They are slowest when the contraction is at its acme; they recover gradually during the decrease of the pain, and regain their full frequency and force during the diastole of the uterus. The probable cause of this slowing is the interruption to the utero-placental circulation under the compression of the vessels in the uterine wall. Kehrer and others attributed it to the compression of the fœtal brain. The latter hypothesis is excluded by observations made by Robert Barnes.[1]

He watched the circulation of the heart in cases where the fœtus expelled from the mother still retained its connection with the placenta. At every contraction the pulsations slowed, and rose again as the contraction remitted. In the same cases when feeble respirations were exerted the pulsations rose exactly as they did when the placental circulation was restored during uterine diastole, and were slowed again when respiration flagged. He thus obtained demonstration that respiration and placental circulation were equivalent in promoting the action of the heart. That the slowing cannot be caused by compression of the brain is proved (1) by the fact that

[1] London Hospital Reports.

it is observed before the membranes are ruptured—that is, whilst the head is protected from compression by the liquor amnii; (2) by the fact that the slowing is observed after the child is born, and thus removed from uterine compression. McClintock and Hardy observed that the fœtal heart's action was depressed under the contractions excited by ergot, and that, if these were long-continued, the heart might cease to beat altogether. But it is possible that ergot may exert a direct toxical influence on the fœtus by entering its blood.

2. The Influence of Contractions and Pain on the Maternal Circulation.—Pain, if sudden and severe, causes a degree of shock which will depress the heart's action. But in the ordinary conditions, the contractions and pain are attended by acceleration of the pulse. Hohl declares that the relation between these two phenomena is so intimate that, if the quickening of the pulse is gradual, reaching its maximum little by little, maintaining it for a certain time, then gradually declining, the contraction also is pursuing a regular course; if, on the contrary, the pulse quickens by starts, the contraction is short and hurried.

The modifications imparted to the uterine souffle under contraction are described by Tarnier. At the beginning of the contraction the souffle becomes suddenly stronger, more snoring, then gradually, as the contraction increases in intensity and becomes general, the souffle diminishes and becomes imperceptible; as soon as the contraction weakens, the souffle returns with all the characters it manifested at the beginning of the contraction, and recovers its habitual sonorousness. These observations furnish further proof that it is by interrupting the placental circulation that the fœtal heart is slowed.

Abdominal Contractions.—The abdominal muscles seldom come into play until the advanced stage of labor, when the fœtal presenting part has cleared the os uteri, and is engaged in the vagina. As Tyler-Smith has shown, "at the time when the liquor amnii is discharged, and the os uteri becomes fully dilated, the motor force of parturition is applied in quite a new direction. The direction in which the fœtus has now to pass is in that of the axis of the lower part of the pelvis, which is forwards and downwards. It is at this point that the expiratory muscles come into play, particularly the abdominal muscles, and the new direction is provided for. Before the dilatation of the os uteri, we had to consider the fœtus as an ovoid mass, and the axis of this ovoid corresponded with the axis of the uterus. After the dilatation, we may speak of two axes of the fœtus—one, the axis of the head, in its long or occipito-mental diameter; the other, the axis of the body of the fœtus. Now, the axis of the head, in a natural presentation, becomes nearly the same as the axis of the outlet of the pelvis, through which it has to pass; and the fœtal body being flexible, readily passes as it descends from the direction of the superior to that of the inferior pelvic axis. The uterus acts under greater advantage when the membranes are ruptured. The same circumstance is equally favorable to the action of the abdominal muscles. A further adaptation becomes visible in the precise time at which the liquor amnii is discharged. When the bulk of the uterus is increased by the liquor amnii in addition to the fœtus, the abdominal muscles are so distended that they can only act with difficulty. But after the diminution of the size of the uterus by the discharge of the waters, the abdominal muscles are more free to act, and it is now that they are called upon to aid in the expiratory actions which propel the head through the vagina. . . . The contractions of the abdominal muscles are so powerful as to be no inconsiderable stimulus to the uterus itself. Thus in this stage, when the uterine contrac-

tions flag, they can sometimes be renewed by voluntary contractions of the expiratory muscles.

"But," continues Tyler-Smith, "there is a cause for the intervention of the respiratory system, as well as the sign of its utility. In the stage of dilatation, the ovarian and uterine nerves were the chief amongst the excitor nerves of the motor actions which then occurred. As soon, however, as the fœtal head, protruding through the os uteri, begins to press upon the vaginal surface, a new set of excitor nerves becomes implicated. The vaginal excitor nerves are the excitors of the expiratory actions of parturition. As long as the internal surface of the uterus alone is irritated, the uterus contracts by itself; but as soon as the vagina is impinged upon, the expiratory force is brought to bear. Another point worthy of observation is, that the excitor nerves of the uterus, except at the extreme dilatation of the os uteri, when the stomach is disturbed, are chiefly in connection with the lower portion of the spinal marrow; but the vaginal excitor nerves are in relation both with the lower medulla and the medulla oblongata. By the lower medulla, and the excitor and motor nerves in relation with it, reflex actions of the uterus are produced by excitation of these nerves; while all the reflex actions of the respiratory system depend upon the medulla oblongata. If the spinal marrow were divided in the middle, there would probably be no respiratory action in parturition, unless the pneumogastric can act as an excitor during labor. Voluntary efforts, and the forcible efforts of emotion, are often mixed up with the pains; but the respiratory acts of this stage of labor are truly reflex in their nature. The expiratory actions occur during the insensibility of puerperal convulsions, when emotion and volition are both suspended. If they were not reflex and physical in their nature, the exhaustion following a strong labor would be far greater than it is. It is a principle of reflex action that it induces no fatigue. (This proposition requires modification.) Hence we see even weak women making powerful efforts, but perfectly refreshed between the pains, and easy and composed after several hours of severe labor."

Tyler-Smith thus describes *the motor phenomena of the contractile part of a pain in the propulsive stage.* "At the coming on of each pain, the patient takes a deep inspiration as a preliminary. Expiration then takes place slowly and forcibly in a succession of gasps, and when the air in the thorax is diminished, it is suddenly removed by hasty inspirations. Each pain consists, as far as the respiratory muscles are concerned, of several sudden and deep inspirations, followed by prolonged and laborious expiratory efforts, with the glottis partially or entirely closed. At the acme of a pain, the glottis and cardia are entirely closed, the glottis only opening partially at intervals, and the abdominal and extraordinary muscles of expiration being forcibly contracted. The diaphragm remains inert, as in vomiting, with the actions of which phenomenon, except that the cardia is closed instead of opened, the efforts of the expiratory muscles in labor may be compared. . . .

"Besides these actions which are involuntary and reflex, the patient voluntarily aids in fixing the thorax by holding some fixed body with her hands, or planting her feet firmly. More than this, she increases all the expiratory actions by strong efforts of the will, and by that emotion of labor which impels her to brave every suffering to effect the birth of the child. At length when the pain can no longer be borne, the short gasp or groan is exchanged for a cry which dilates the glottis, and the pain and contractions subside. This cry is a motor action, excited by the emotion of pain, and instantly relieves the uterus of all extrauterine pressure. Thus the glottis may be compared to a safety valve. . . . By the influences of volition we have this valve entirely under our control, to open or close it, as may be necessary."

This opening of the glottis under the emotion of pain is the illustration of the physiological use of pain.

The *final act of expulsion*, to quote again from Tyler-Smith, "is the shortest of the whole process, but it is the most important and decisive. The actions of the propulsive stage continue with unabated vigor. The uterus contracts with full power, and the respiratory muscles act with immense force. The intervals between the pains diminish as the close of the struggle approaches; and there is often a perfect storm of uterine contraction, without sufficient intermission to enable us to say distinctly where one pain ends and its successor begins. When the fœtal head is actually passing, a new set of actions make their appearance. The perineum, after being distended to the utmost, is now retracted over the head by the action of the levatores ani; the sphincter ani and the sphincter vesicæ dilate suddenly, the vagina contracts upon the advancing mass, and the head glides rapidly into the world. The dilatation of the two sphincters, between which the vagina is placed, compensates admirably for the absence of a perfect sphincteric muscle at the outlet of the parturient canal. The effect of this double dilatation is that at the precise moment when there is the most imminent danger of laceration, there is a sudden diminution of tension from the parts endangered. The dilatation of the sphincters is partly dependent on the sensation and emotion of severe pain, and partly on the reflex dilatation peculiar to the sphincteric muscles. This explains the defecation which frequently occurs at this time, and which has been looked upon only as a disagreeable *contretemps*. (The relaxation of the sphincter ani is an undoubted factor, but the more efficient cause of the defecation is, we believe, the pressure of the advancing head upon the rectum, by which the contents of this canal are squeezed out.) At the same moment that the orifices of the rectum and bladder are thrown widely open there is generally a dilatation of the glottis. Its effect is suddenly to take away the expiratory pressure from the expulsive action. Without this combined action of the glottis and the sphincters of the rectum and bladder for the defence of the ostium vaginæ, recto-vaginal laceration must be a much more common accident of parturition."

3. INDICATIONS FURNISHED BY THE BAG OF MEMBRANES.

The "bag of membranes" technically means that part of the sac of liquor amnii which presents at, or protrudes through, the os uteri externum. This normally forms in the first or dilatation stage, appearing as the os dilates. It is indeed one of the forces which effect the dilatation of the lower segment of the uterus and the cervix. If the head presents, and the balance of the parturient factors is preserved, this bag usually advances unbroken until the dilatation is far advanced. It undergoes gradual distention and thinning preparatory to bursting.

During a pain the bag becomes tense and more protruded, so that the encircling os uteri is felt as a tight ring upon its circumference; during the uterine diastole, the capacity of the uterus increasing, the waters ebb back into its cavity and the bag of membranes becomes flaccid, and sinking upon the head it may even become not easy to distinguish. The feeling the flow and ebb of the waters in their containing bag gives therefore indication of the alternate systole and diastole of the uterus. So long as the bag of membranes remains intact, the action of the uterus is necessarily spent upon the contained fluid, exerting little or no pressure upon the fœtus. Under the hydrostatic law of fluid-incompressibility the fluid seeks to escape, and this it does by the most yielding gate—that is, the os uteri—which is forced open by it. Three great functions of the liquor amnii in labor are exercised simultaneously—the fœtus is protected from pressure, the placental circulation is maintained, and the cervix uteri is dilated. When the cervix is

dilated the bag bursts, and the passages are prepared for the safe transit of the fœtus. The uterus, now aided by the expiratory muscles, presses upon the fœtus and propels it onward.

The Significance of the Various Forms Presented by the Bag of Membranes.—The presenting part of the fœtus may be presumptively diagnosed by the characters of the bag of membranes. If the bag is flat and expanded, the waters forming a thin stratum, the probability in favor of a cranial presentation is great. This probability rises if, during the diastole, the finger can easily press back the membrane upon an expanded hard rounded body. In some breech presentations the characters of the bag of membranes are similar, but less marked. On the other hand, when the bag is protruded slowly in a cylindrical shape, and no part of the fœtus is felt presenting above it, the inference is justified that some abnormal presentation, as a foot, cord, or shoulder is presenting. This form is also produced when, the cervix dilating slowly, the presenting part cannot enter the pelvic brim, whether the cause be malpresentation, or undue size of the fœtal head, or malformation of the pelvis. Moreau further pointed out that it was liable to be produced by obliquity of the uterus.

Tarnier describes a *pyriform* character, as when the membranes make a kind of bladder in the vagina, and a constricted part at the level of the os uteri. This is frequently observed when the fœtus has perished during gestation.

In cases of twins there may be a *double bag of membranes*, but most commonly one bag presents at a time.

When the *placenta presents, the part of the membranes reached is thick and rough*, and one may sometimes trace a margin into the spongy mass of the placenta.

When the membranes rupture, the flowing liquor amnii is useful in lubricating and mollifying the vaginal canal. But the vagina does not depend upon the rupture of the bag for its lubrication. The membranes are permeable to fluid under pressure. Tarnier and Pinard demonstrated this important fact by three series of experiments. In the first they stretched a piece of the membranes taken from an ovum recently delivered over one end of a glass tube which was then filled with water. After some hours droplets of water were found on the outer surface of the membrane. Some water had, therefore, oozed through. This is not the same thing as osmosis. In a second series they used liquor amnii. The result was the same. In the third series they subjected the contained fluid to pressure. Some fluid quickly oozed through.

Membranes vary in permeability. The amnion is more permeable than the chorion lined with the caduca. In these experiments it was found that a certain quantity of fluid gathered between the amnion and chorion, forming a true amnio-chorial sac. A similar condition may be observed in practice. Thus, after having ruptured the chorion and let out some liquor amnii, the amniotic sac is still felt distended under uterine contractions, and in its turn has still to be ruptured. It is important to recognize these *false or secondary bags of liquor amnii*. We occasionally observe considerable discharges of water preceding by some hours or days the bursting of the membranes. These discharges may be due to the formation of such false intermembranous bags. But this explanation will not apply to some cases. Similar rapid and copious watery discharges occur early in pregnancy and in nonpregnant women. They are the result of active glandular secretion from the cervix uteri.

The transudation of liquor amnii through the membranes is a provision of

accommodation to reduce excessive tension, and to postpone to the due time the rupture of the sac, and perhaps to avert rupture of the uterus.

The Rupture of the Membranes.—The membranes commonly burst all at once. Sometimes the amnion bursts first. Ribemont-Dessaignes has made many interesting observations, clinical and experimental, on this subject.[1] Sometimes the bursting is delayed until the sac is protruded beyond the vulva, the presenting part of the child being born covered or capped by the membranes. When this happens the child is said to be born with a *caul*. This caul is endowed by superstition with the virtue of preserving its possessor from drowning, and there are people who in this faith will give money for a caul.

Sometimes, again, *the membranes do not rupture at all*, but *the ovum is expelled entire*. In such cases the fœtus is in danger of perishing from asphyxia and drowning. As soon as the placenta is separated from the uterus, the fœtus makes an inspiratory effort, and will not long survive without air. Whenever this event occurs, it is therefore important to rupture the sac quickly to extricate the child. And if we have the opportunity, the membranes should be ruptured when they present at the vulva.

In not a few cases *the membranes burst prematurely*—that is, before the dilatation of the cervix. The labor may in consequence be retarded, but this is not necessarily the case. If the labor is at term, and the presentation is of the vertex, neither mother nor child may suffer. But in presentations of the trunk or shoulder, the escape of the waters permits the uterus to compress the fœtus, and the operation of version is made much more difficult.

No definite time elapsed between the bursting of the membranes and the birth of the child, but usually expulsive action sets in vigorously and effectively.

Mode of Discharge of the Liquor Amnii.—This may be effected silently and slowly, or rapidly and with noise. The first mode is observed in head presentations. When the membranes burst, a moderate quantity only flows at the time. The head, carried down upon the cervical ring, blocks it; when the diastole occurs, the head, like a ball-valve, recedes, and more liquor amnii escapes. But not seldom a considerable quantity remains ponded up in the upper part of the uterus until the child is expelled, when it is discharged in a gush.

The liquor amnii is more apt to be voided quickly and entirely when the presenting part is not the head.

The gradual evacuation of the liquor amnii must be regarded as one of the provisions of accommodation which regulate the several factors of labor, and which maintain the action in due relations of time and force.

Useful indications may be drawn from *the characters of the liquor amnii*. To observe this it is a good plan to catch the liquor which flows at the first gush in a small bowl. We thus get a fair sample, and avoid much soaking of the bed. The ordinary appearance of the liquor is that of a clear or slightly turbid yellowish citron color. Sometimes it is turbid and dark-green from meconium. This, although due to premature evacuation of the child's intestine, commonly taken to be the result of an inspiratory effort, is quite compatible with the expectation of a living child. But it may serve as a warning that aërial respiration has become necessary; and delivery should be expedited should no serious contraindication be present. This meconium-stained liquor amnii is not uncommon in breech-labor.

Not seldom we hear of *cases in which the membranes are said to have burst days and weeks before true labor*. The reality of the bursting may well be

[1] See Tarnier and Chantreuil.

doubted. Some of these apparent ruptures are examples of the rupture simply of the chorion and of the escape of fluid which had collected in a false sac between it and the amnion, this latter membrane remaining intact. Other cases are examples of the rapid secretion of watery fluid from the mucous membrane of the cervix, and perhaps of the vagina. And, in some cases, an involuntary escape of urine has been mistaken for liquor amnii. In these cases it has nearly always been noted that the membranes burst again at the due time, discharging the due quantity of liquor amnii, or even more. It has been supposed that the membranes, having ruptured, may reunite, the amniotic sac being reintegrated; or that a large quantity may transude under pressure through the unbroken membranes. Distinct proof of these hypotheses is wanting.

Premature escape of fluid in considerable quantity often gives a false alarm of impending labor. The physician determines the significance of such discharges by examination. If he finds no evidence of uterine activity by external exploration, and no marked or progressive dilatation of the cervix uteri, he may conclude that labor has not fairly set in, and may safely retire to await another summons.

4. **The "Show," or Escape of Blood-streaked Mucus.**—Closely connected with the formation of the bag of membranes, and often preceding it in time of observation, is the muco-sanguineous discharge called "the show." We have before called attention to the copious creamy matter which covers the vaginal portion and upper part of the vagina during pregnancy. This is not a glandular secretion, but is strictly the result of rapid exfoliation of the pavement-epithelium of these parts under active hyperæmia. Besides this, the enlarged glands of the uterine neck secrete a thick viscid mucus which collects in the cervical cavity, forming a *gelatinous plug*. At the commencement of the stage of dilatation portions of this mucus escape. This will stick to the examining finger, or may be passed spontaneously, and spot the linen. Generally it is yellowish or plum-colored. The color depends upon the proportion of blood mixed with it. Sometimes the blood is seen in streaks. Slight blood-tinging is attributed to the separation of the chorion from its connection with the uterus through the decidua. Minute vessels are torn across.

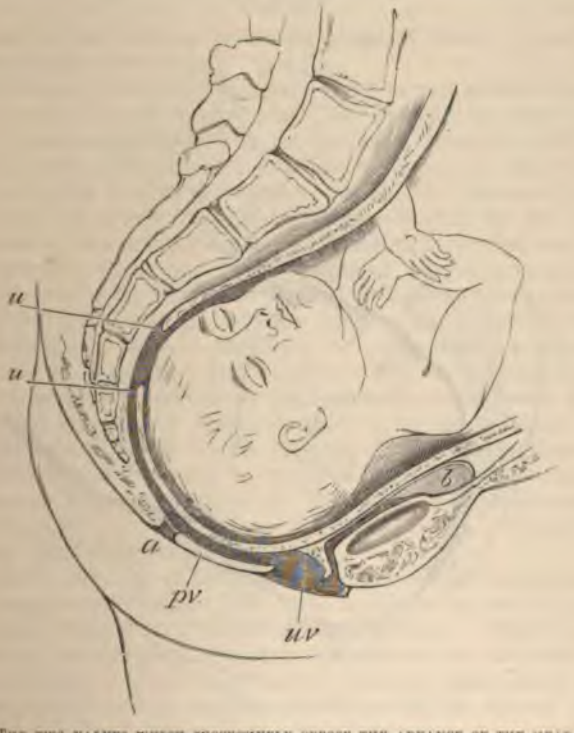
Tarnier connects this mucous discharge with the liquor amnii which oozes through the membranes before their rupture. It thus acquires new properties; it becomes more unctuous, more running, and more fit to lubricate the external genitals. This, says Tarnier, is so true that if we find the vagina scarcely moist when we examine, we may almost affirm that labor is but little advanced, and, on the contrary, if the vagina is well lubricated, permitting the introduction of the finger easily, without the aid of a fatty body, it is very probable that the os uteri is already well dilated.

5. **The expansion of the vagina, perineum, and vulva** has been described in its motor phenomena. It remains to describe some features in the last stage of dilatation of the cervix uteri and of the perineum in their bearing upon the mechanism of labor, which were very imperfectly appreciated before Robert Barnes's views were published.[1] Towards the end of the dilatation stage, especially in primiparæ, the axis of the uterus approaches coincidence with the axis of the pelvis, its lower pole pointing to the middle of the sacral hollow. This relation causes the centre of the expanding os uteri to be opposite the sacral hollow, with its posterior margin directly under or even above the sacral promontory, according to the degree of dilatation, whilst the anterior margin of the os will be carried close to the sacral hollow, the

[1] Obstetrical Operations.

anterior wall of the lower segment of the uterus capping the child's head. It thus happens that on examining at this stage, the finger carried in the axis of the pelvic outlet, does not enter the os uteri, but impinges upon the anterior part of the lower segment of the uterus, bulged out by the head. To find the os, the finger must travel far back, and then curve forwards under the promontory in order to find the anterior edge of the os (see Fig. 113, *u u*) and enter the cervix. On referring to the diagram, it will be seen that the anterior part of the lower segment of the uterus forms an inclined plane in the pelvis, which necessarily guides the head into the sacral cavity so as to clear the promontory, thus describing "Barnes's curve." In the typical normal pelvis this curve is slight, but it is always a factor in de-

FIG. 113.



THE TWO VALVES WHICH SUCCESSIVELY OPPOSE THE ADVANCE OF THE HEAD

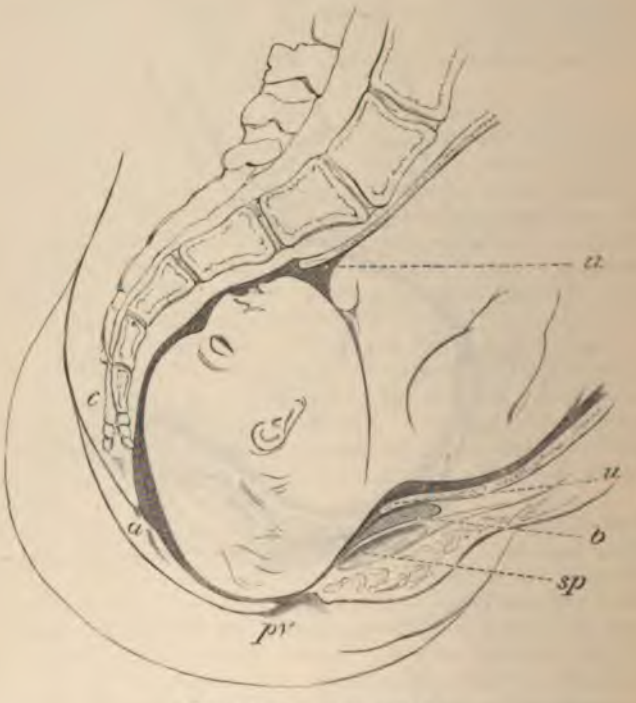
uv. First or uterine valve. *pv*. Second or perineal valve. *u u*. Os uteri. *b*. Bladder.

termining the course of the head. Where the promontory projects unduly, this curve assumes greater importance. This disposition of the anterior wall of the lower segment of the uterus Robert Barnes calls the first, or anterior, or uterine valve (see Fig. 113, *u v*). It is sometimes carried down before the head to the very floor of the pelvis, so as to touch the second or perineal valve (Fig. 113, *p v*), which we will now describe. The head fairly in the pelvic cavity, the uterine valve has done its duty and ought to retreat. It usually does so, being drawn up behind the symphysis. The head then has only the vulva to traverse. It now encounters a second plane or valve, formed by the perineum or floor of the pelvis. This, regarded as an extension of the lower or forward curve of the sacrum and

coccyx, rules the axis of the outlet of the pelvis, which is the route the head must take. Continuing expulsive efforts bearing upon the child's spinal column, the head is extended and is directed under the symphysis in Carus's curve through the outlet. Thus the uterine valve or plane guides the head into the pelvis; the perineal valve or plane guides the head out of the pelvis by the axis of the outlet.

When the head reaches the pelvic floor, it enlarges the outlet first by pushing back the coccyx, secondly by depressing and distending the fleshy prolongation of the pelvic canal, transforming it into a channel along which the head is guided. All the tissues forming the pelvic floor are stretched; the recto-vaginal septum is pushed against the rectum, which it flattens; the anus, often surrounded by a rim of hemorrhoids, is widely opened, so that

FIG. 114.



THE LOWER OR PERINEAL VALVE.

a. Anus. *b*. Bladder. *c*. Coccyx retropulsed. *sp*. Symphysis pubis. *u u*. Uterus. *p v*. Perineal valve.

the mucous membrane of the anterior wall of the rectum is exposed. When the head is bulging out the perineum, the stretching open of the anus is often so great and the tissues are so thinned that the finger may easily pass into the anus under mistake for the vagina. Sometimes the edge of the anus cracks under the distention, and troublesome fissures result.

When the expulsive action subsides, the head, which may have bulged in part between the labia vulvæ, retreats, and the perineum becomes flaccid. This retreat of the head is often ascribed to the elasticity of the external soft parts, which carries the child up again towards the abdomen. The true reason is found in the relaxation of the uterus and abdominal muscles, the action of atmospheric pressure, and the suction power of the abdomen. After

the child is born, this vacuum or suction force is very manifest. Air may be drawn into the uterus if the woman lies in the prone posture, and the perineum is held back. This fact supplies an argument in favor of the dorsal position, with the shoulders slightly raised. Thus the uterus permits the fœtus to fall back a little into its cavity, and the enlarged abdominal cavity receives the uterus, the pelvis being *pro tanto* relieved. When the uterus and abdominal muscles again contract, the uterus and fœtus are again propelled against the perineum until at last the head is driven through; the perineal valve or plane is carried back, slipping over the face. In primiparæ the anterior edge of the perineum, the fourchette, is almost invariably torn.

Barnes's uterine and perineal planes or valves are identical with the pubic and sacral segments of the pelvic floor described by Hart and Barbour.

The process of the third or placental stage of labor, or, as Tyler-Smith called it, the *supplemental stage*.

While the body of the child is born by the motor actions described, the contracting uterus follows closely upon it in its descent, and the action of the uterus, excited at this time from the immense irritation of the vagina by the advancing fœtus, is frequently sufficient to throw off the placenta, and lodge it in the upper part of the vagina. When the placenta is not cast in this way by the last expulsive pain, it remains quietly in the uterus until the appearance of the first after-pain. During this interval the uterus contracts with tolerable firmness. If the placenta has been expelled into the vagina, its presence here excites after awhile bearing-down pains and contraction of the vagina, similar to those of propulsion and expulsion, only far less considerable. The vagina may be regarded as a musculo-elastic canal; it tends to contract when emptied; but its contractile power is, if not paralyzed, greatly weakened by the enormous distention it has recently undergone; and the body it has to contract upon, the placenta, is soft and plastic, easily moulding itself in the bag which the vagina forms; it is not solid enough to be easily driven forward, so that commonly some adjuvant force is necessary to effect its removal. This may be applied *à tergo* by compression of the uterus, as will be described hereafter, or *à fronte*, by traction upon the cord and placental mass.

The child and placenta expelled, contraction is still imperatively needed to secure against hemorrhage. The hæmostatic process will be particularly described when treating of post-partum hemorrhage. Here it is enough to state that when the placental separation is effected, the abraded surface of the uterus is strongly excitor; and as the placental mass passes through the vaginal passage and ostium vaginæ, excitation which insures full uterine contraction is supplied. It is a character of the utero-vaginal canal that at the end of labor all the surfaces are more actively excitor, and the answering motor contractions become more rapid and more easily provoked. During severe labor irritation of the os uteri or of the vagina will often increase the pains in a moderate degree, but now the introduction of the hand will excite instant and forcible contraction of the uterus. The extrauterine excitors of uterine action also come into play in a remarkable manner. Slight irritation of the mammary excitor nerves excites distinct contractions of the uterus. Drinking even bland fluid will act in similar manner. Emotion from thinking of the child will generally produce an after-pain. And it is under reflex excitation of this kind that continuous contraction is kept up, promoting involution and the return of the uterus to the ordinary state of a non-motor organ.

The duration of labor varies in different and even in the same subjects.

Comparing, in the first place, natural labors only, we find, *first*, that the average duration is greater in primiparæ than in multiparæ. Notwithstanding the great nervous and muscular energy usually found in young *primiparæ*, the resistance opposed by the soft parts is absolutely and relatively greater. The uterine muscle is not so well developed, its power is less. Counting the commencement of labor from the first pains, it may be stated generally that the duration is from twelve to fifteen hours; that the stage of dilatation is about equal to that of expulsion. It is commonly said that primiparæ advanced in age—that is, at forty or more—suffer more protracted labors. This is generally true; but marked exceptions are not rare.

Hereditary types of labor are observed. Through several generations slowness or rapidity of labor has been noted.

In *pluriparæ* the average duration is about seven or eight hours, and the stage of expulsion is often shorter than that of dilatation. The expulsive energy may be as great as, or greater than, in primiparæ, whilst the resistance is both absolutely and relatively less. The quickest labors may be expected in young women parturient for the third, fourth, or fifth time; when parturient for the ninth or tenth time, and approaching forty years of age, the labor may be more protracted.

Influence of Station in Life, Race, and Climate, upon the Duration of Labor.

It is generally believed that in hot countries labor is quicker than in cold. But we are not aware of any exact data bearing upon this point. The tales told of women of barbarous races bringing forth without pain and without danger must not be hastily accepted as universally true.[1] Trustworthy reports assure us that protracted, difficult, even fatal labors are not unknown amongst them. It is certain, however, that women brought up in luxury and idleness have to undergo more protracted labors than have women brought up in the country and inured to hard work.

The Influence of Labor upon the Maternal Functions.

The principal functions undergo certain modifications usually transient under the influence of the uterine contractions. The nervous disturbances are the most constant and the most various. At the outset there is commonly some sense of anxiety, which quickly disappears as the pains follow with regularity. Then, as the orifice dilates, a degree of agitation is observed. Frequently a rigor sets in; this is reflex; a similar phenomenon is observed at the commencement of micturition even in men. About this time vomiting is not uncommon. It is attended by relief. There is an old adage amongst women that "sick labors are safe." In some women a temporary delirium occurs, especially at the acme of the expulsive stage. Generally, however, the nervous susceptibility lessens as the expulsive stage advances. The store of nervous energy is concentrated upon the focus of physiological activity, where it is healthily utilized. During labor women not seldom complain of *cramps*, referred to the upper and inner side of the thighs, or even to the whole length of the lower limbs. The first kind are due to the compression of the obturator nerve by the fœtal head; the second to the compression of the sciatic plexus by the head. Cramps along the inner side

[1] Labor among Primitive Peoples. Englemann, 1883.

generally of one thigh are often complained of by women towards the end of pregnancy. Robert Barnes, many years ago, registered the statements on this point of women applying to be attended during labor, and found that he could predict the position of the head by noting which thigh suffered. Thus the left-thigh cramps foretold a first occipito-anterior position, and right-thigh cramps the second position. Similar observations hold good during labor.

The *circulation* is accelerated, the pulse becomes stronger as well as quicker. Arterial tension is increased.

Calorification is modified. The heat of the body is raised; the thermometer applied to the armpit, mouth, or vagina indicates a higher temperature than at the end of gestation. The thermometer placed in the uterus itself indicates a still higher temperature. This is accordant with the physiological law that increased physiological action entails a richer supply of blood and rise of temperature. This phenomenon is called *local hyperthermia*. Peter, Schroeder,[1] Winckel,[2] and Hennig found that the temperature in the uterus during labor was higher than in the vagina, and that it rose during the contractions. Grüber observed that the rise in temperature was very slight in normal labor, but very marked in abnormal labors. We must bear in mind that the observations were mostly made in lying-in hospitals, where prevailing conditions often disturb the normal processes. But making due allowance for this source of fallacy, it may be accepted that there is a real rise of general temperature during labor, and a special rise in the uterus during contraction.

In some cases the skin remains dry and hot during labor, but often it is bathed in perspiration. The face becomes red, the tongue pale and rather dry. These phenomena are especially pronounced when the dilatation stage is protracted.

Respiration is modified. The movements are increased. Winckel says[3] the increase is as 20.7 to 18.7 in the minute. They are more frequent during the intervals between the contractions. During the expulsive contractions, when the respiratory muscles are called into action, the glottis being closed, the movements are necessarily suspended.

Modifications of the Functions of the Fœtus Produced by Labor.

The phenomena presented by the *circulation* have been already described when studying the effect of the uterine contractions.

Respiration.—During gestation the fœtus makes no respiratory movement. Respiration and its attendant nutritive processes are carried on by osmosis—that is, by gaseous and liquid interchange between the maternal blood and the fœtal blood in the placenta. This goes on during labor. But if the placental function is unduly interrupted, inspiratory efforts are made, under which meconium may be voided into the liquor amnii, and some of this fluid may be drawn into the air-passages.

Occasionally, when the membranes are burst, if the face presents, or if the obstetrist has passed his hand into the uterus to practise some manœuvre, air may be conducted along with it, and reaching the child, may be inspired by it; and thus a phenomenon which has been much contested may arise. This is—

Vagitus Intrauterinus.—On expiration the fœtus, still *in utero* or *in vagina*, may utter a cry. The possibility of this has been doubted. Vel-

[1] Schwangerschaft, Geburt und Wochenbett, 1867.
[2] Klinische Beobachtungen zur Pathologie der Geburt, 1869. [3] Loc. cit.

peau, with pithy cynicism, said: "Since educated men, worthy of faith, say they have heard it, I believe; but if I myself had heard it, I would not believe." And, indeed, it is one of those things that demand close, intelligent, and repeated observation to carry conviction. Certain it is that sounds easily misinterpreted by unskilled and impressible minds are heard which are not due to this cause. A little air getting into the uterus or vagina has given rise to sounds which we have known the bystanders to attribute to the child, yet the child has been dead.

The evidences upon which we rest our belief in the reality of vagitus uterinus are these:

1st. The proofs now generally accepted that the fœtus *in utero* makes real inspiratory efforts when the placental circulation is interrupted.

2d. The fact that air may find its way into the vagina and uterus and come into contact with the child's face.

3d. The fact that during the diastole of the uterus there is a degree of suction force towards the cavity, and such relaxation of the uterus, that the chest walls of the child may readily expand.

4th. The fact, which we and others have verified, that when the face presents, and is still at some distance from the vulva, air admitted to the vagina reaches the child's face, and is inspired. In these circumstances we have heard the child cry, and the vaulted chest when born shows that it had breathed. Indeed, in these circumstances, breathing has been maintained either by keeping a finger or a tracheal tube in the child's mouth.

If air can thus enter the child's lungs when the face is in the vagina, it is reasonable to infer that it may do as much when the face is still in the cavity of the uterus.

Lastly, there is the evidence of authority, positive evidence of men not open to impeachment of ignorant credulity, and too multiplied to be set aside by sceptical negation. Amongst the witnesses to the fact are Marc, Baudelocque the younger, Depaul, Winckel, to whom we may add ourselves. Several of the instances recorded have been cases of foot or shoulder presentation, where the hand was introduced into the uterus for the purposes of turning or extraction.

The Management of Simple Labor.

What to Observe in the Parturient Woman.

1. The aspect and general condition.
2. Pulse, respiration, temperature.
3. Feel the abdomen, to estimate size, firmness, movements of uterus, position of uterus; also the changes in these conditions during the pains.
4. Inquire as to pains, their seat, order of recurrence, duration, intervals. Note the discharges, mucus, blood, watery.
5. *Vaginal Examination.*—Lubricate the fingers with carbolized vaseline, 1 in 30.

The first thing to determine is: the reality of pregnancy; the next is: the reality of labor. Note the time of beginning of opening of the os uteri. This marks the beginning of the *first stage of labor.* These points settled in the affirmative, the finger takes note of the condition of the vulva, of the vagina as to lubrication, dilatability; of the os uteri, its position; is it open? if so, to what degree? is it dilatable? does it alter during a pain?

The presentation: this should if possible be made out; the bag of membranes: does it bulge during the pains? is it thick, resisting, or thin? is it

still entire or burst? Catch the liquor amnii in a bowl; inspect it; is it limpid, turbid, pale, or discolored? note the quantity.

Stethoscopic observation may be applied to the fœtal heart.

So far there is little to do beyond observing the course of events, and sustaining the courage of the parturient. Care should be taken to secure the emptying of the bladder. A little light nourishment may be given. If pain be urgent, a sedative draught of 15 minims of laudanum may be given. If the patient or her friends call out for chloroform, evade complying during this stage. The continued presence of the physician during this stage is not necessary, but when dilatation is fairly progressing in a pluripara it is wiser to keep within call.

During the premonitory stage, or if not then done, during the dilatation stage, it is useful to empty the bowels by enema; the subsequent progress of the labor is facilitated, and annoyance to patient and physician is avoided.

The main duty of the physician is to take care that no undue interference or meddling is practised. Especially the parturient should be enjoined not to attempt "to help herself" by forcing efforts. These do not advance the labor, and only exhaust the patient's strength.

Take care that no ergot or other oxytocics be administered.

Take care not to rupture the membranes.

Note the time at which the membranes rupture. This marks the beginning of the *second stage of labor.*

Observation is now directed to the advance of the presenting part; the rotation and other adaptive movements.

The formation of the caput succedaneum or corresponding swellings in presentation of parts other than the head.

Note the condition of the woman as affected by the labor; pulse, respiration, state of skin, rigors, injection of face, or pallor? vomiting? defecation?

Note the capping of the child's head. 1, by the uterine valve; 2, by the perineal valve; the condition of the vulva and perineum; the rotation and extension of the presenting part.

Observe the evolution of the child during its birth.

Note the state of the child when born; sex, development, alive or dead; feel the cord, feel the thorax for heart-beat, observe aspect of face, cyanosed or pale; are limbs limp or flexed upon trunk? Respirations, character of.

The *plastic deformations, i. e.*, shape of head; are cranial bones entire?

From the beginning of this stage, as a rule the patient, if a pluripara, should not leave her bed; in the case of a primipara, however, if the pains flag, she may get up and walk about a little at intervals. This has the effect of awakening the uterine contractions, and lessening the tedium of expectation.

Sometimes, when the head is bulging the perineum, the woman feels an imperious want to relieve the bowel, and she may try to get on the night-stool. This should on no account be allowed. We have known the child to be precipitated into the stool, the cord broken, and the child in danger of drowning in the contents of the stool. And there is no slight danger to the mother of hemorrhage and inversion of the uterus.

The care of the perineum. It has been much disputed whether the perineum should be "supported," or left to take care of itself. We believe there is now a general consensus or opinion in favor of supporting the perineum. The question, therefore, is simply *when* to do it, and *how* to do it.

When to Support the Perineum.—It is of no use to begin before the head is distending the vulva. All pressure upon the pelvic floor before this time is waste trouble, and injurious by contusing the parts. Besides, as

Tyler-Smith pointed out, pressure upon the perineum may excite uteri contractions, and thus disturb the due order of the parturient process. T proper time to give support is when the head is gliding on through the vulv stretching the perineum, thinning it out, so that it threatens to burst.

How to Support the Perineum.—During the expulsive stage a fing is applied from time to time to the head and carried back to the edge of t perineum to take note of the advance of the head, and of the degree stretching of the perineum. When this is great, and increasing before t advance of the head, support duly rendered may help in two ways—first, t palm of the hand, so spread out as to rest upon the coccyx behind and up the pelvic floor, prolongs and strengthens the pelvic floor, retarding the t precipitate exit of the head, giving the soft tissues time to stretch, and directing the head under the pubic arch, excess of pressure upon the edge the perineum is avoided; secondly, by pushing forward skin from beh and the sides, the capacity of the perineum is somewhat increased. Supp is given during the pains, and remitted during the intervals, to enable t circulation to be restored. Free lubrication with vaseline or oil, and occa sionally fomentations, make the dilatation more easy.

Laceration of the perineum may begin in two ways—first and most commonly by tearing at the extreme edge, and then the rent may extend backwards in the median line splitting up the pelvic floor to the edge of the sphincter ani or through it, or the rent may run laterally; secondly, the perineum, bulging out in the middle, may burst at this part, and the rent may run forward through the fourchette and backwards through the sphincter ani; or the child may be driven bodily through the central hole, the edge of the perineum keeping entire. The child performs a feat similar to the circus feat of leaping through a hoop covered with paper.

It is obvious that the extended palm of the hand, well supporting the pelvic floor, will obviate this latter accident, and that lengthening the perineum forwards, and directing the advancing head well under the pubic arch, will much lessen the risk of tearing at the edge of the perineum.

When the occiput is turning up under the pubic arch, the hand of the obstetrist grasping the head steadily pushing it forwards, may greatly aid the extension movement. If want of driving power is observed at this time, steady pressure upon the fundus of the uterus will, by propagated force along the child's spine, still further assist the propulsive and extension movements. Until the stage of expulsion is advanced the posture of the patient is not very important. She may seek ease by varying it. But when the head is engaging in the vulva, the period of final crowning, the posture assumed may favor or lessen the risk of the perineum being torn. Whether the posture be dorsal, as in France, or the left lateral, as in England, the knees should be flexed upon the abdomen, and held slightly apart during the evolution of the head. The parturient instinctively assumes this posture. It takes off a little tension from the perineum, and brings the pelvic axis into more favorable relations for the passage of the head.

The perineum may still be ruptured by the stretching of the shoulders if these be driven through abruptly; the perineum should, therefore, be supported during this stage.

Playfair, not without reason, objects to the term and practice of "supporting the perineum," and proposes to substitute "relaxation of the perineum." This is effected by the manœuvre described of pushing the skin of the perineum and external labia forwards and towards the median line. The perineum is thus supplemented and rendered less rigid. Goodel puts a

finger in the rectum and draws the structures in front forward, so as to relax the fourchette.

The Cord.—As soon as the head is born it is proper to pass a finger round its neck to discover if the cord be coiled around it. If this is the case, there are two ways of dealing with it. First, if the head is stationary, and the cord be not tightly embracing the neck, a gentle attempt may be made to draw the encircling loop forward over the occiput and head, so as to liberate it. But should there be any difficulty in executing this manœuvre, it is better not to lose time, which may involve two distinct calamities—first, strangulation of the child; secondly, dragging by the shortened cord upon the placenta and uterus, thus disposing to rupture of the cord at the placental end, or detachment partial or entire of the placenta, leading to hemorrhage; or if the placenta remain adherent, possibly to inversion of the uterus. At any rate, the normal course of labor will probably be disturbed.

The simple, prompt, and effective escape from these accidents is to cut the cord at the most convenient point. This done, and holding the two cut ends, a ligature may be applied to each to meet the possible complication of a second child *in utero* drawing its blood-supply from a common placenta, the vessels of the two fœtuses anastomosing. The improbability of this event is so great that it might, perhaps, safely be disregarded. Another event is more probable—blood may escape from the fœtal end of the cord, and thus endanger the child. In the great majority of cases, the head having emerged and the chest quickly following, air is drawn into the lungs, the circulation assumes the course determined by aërial respiration, and the blood-current is turned off from the umbilical vessels. Still, if we cannot tie both ends of the cord—we must tie both because we cannot tell which is in communication with the fœtus—it only remains to expedite the delivery of the trunk, so as to tie the cord near the umbilicus in the usual way. This is done by gentle traction upon the head by the hands, aided by "expression"—that is, by compressing the fundus and sides of the uterus.

There is no need to tie the placental end of the cord unless we suspect twins; the little blood that oozes from it does not come from the mother; it is simply that part of the fœtal blood which circulated in the placenta.

The third stage. The cord is tied. The proper time for tying it.

Feel above pubes, state of uterus, and contractions.

Ascertain state of bladder.

Trace cord into vagina to ascertain if its insertion is within reach.

Observe state of woman, pulse, respirations.

Flow from vagina, hemorrhage.

Trace state of uterus after expulsion of placenta; is there a second child?

The placenta is cast out or expressed.

Examine placenta minutely. Is it entire, as to its cotyledons and membranes? Observe relation of rent in membranes to nearest margin of placenta; how did placenta pass out of vulva, edgewise, or like a reversed umbrella, membranes covering maternal surface? Does it show signs of disease, fatty, calcareous, or other tissue change? Form; relation of insertion of cord to placental circle; is placenta single, diffuse, or does it show stray cotyledons?

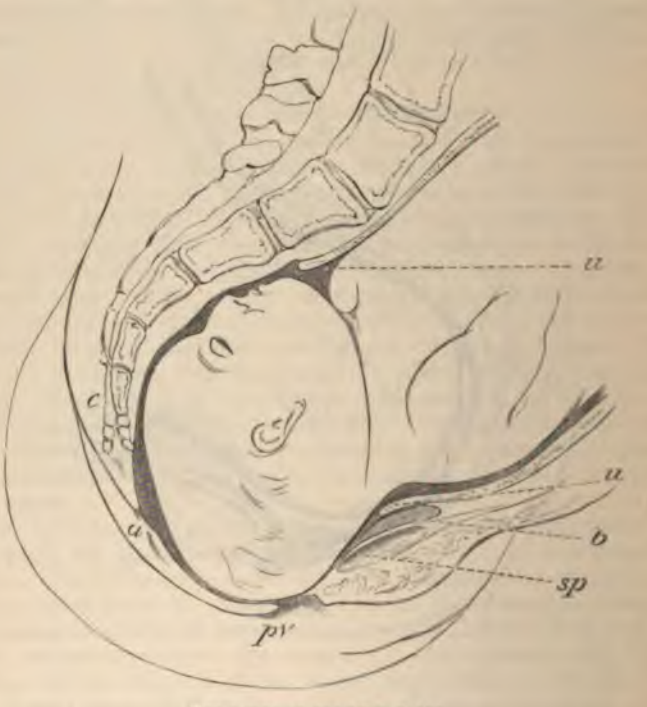
Examine vulva and perineum; intact or torn, extent of injury; thrombus.

The parturient becomes a puerpera. The binder is applied.

coccyx, rules the axis of the outlet of the pelvis, which is the route the head must take. Continuing expulsive efforts bearing upon the child's spinal column, the head is extended and is directed under the symphysis. Carus's curve through the outlet. Thus the uterine valve or plane guides the head into the pelvis; the perineal valve or plane guides the head out the pelvis by the axis of the outlet.

When the head reaches the pelvic floor, it enlarges the outlet first by pushing back the coccyx, secondly by depressing and distending the flesh prolongation of the pelvic canal, transforming it into a channel along which the head is guided. All the tissues forming the pelvic floor are stretched; the recto-vaginal septum is pushed against the rectum, which it flattens; the anus, often surrounded by a rim of hemorrhoids, is widely opened, so that

FIG. 114.



THE LOWER OR PERINEAL VALVE.

a. Anus. *b*. Bladder. *c*. Coccyx retropulsed. *sp*. Symphysis pubis. *u u*. Uterus. *p v*. Perineal [illegible].

the mucous membrane of the anterior wall of the rectum is exposed. When the head is bulging out the perineum, the stretching open of the anus is often so great and the tissues are so thinned that the finger may easily pass into the anus under mistake for the vagina. Sometimes the edge of the anus cracks under the distention, and troublesome fissures result.

When the expulsive action subsides, the head, which may have bulged in part between the labia vulvæ, retreats, and the perineum becomes flaccid. This retreat of the head is often ascribed to the elasticity of the external soft parts, which carries the child up again towards the abdomen. The true reason is found in the relaxation of the uterus and abdominal muscles, the action of atmospheric pressure, and the suction power of the abdomen. After

retractility. To this force is added the active contraction of the muscular coat.

The placenta itself is detached before the membranes. The mode in which the placenta is cast out of the uterus has lately been much discussed. It is often observed that when the placenta is withdrawn from the vagina, it is inverted—that is, the fœtal surface comes first, and the membranes following cover the maternal surface. This is of course the reverse of the relations of placenta and membranes *in utero*. On the other hand, when no traction is made upon the cord, and the expulsion of the placenta is effected by the natural forces, it is *frequently* found that the maternal surface is external, whilst the membranes preserve their natural relations, covering the fœtal surface and the cord.

Recent text-books give comparative figures of these two appearances, one that representing the "inverted umbrella" disposition from Schultze, who adopts Baudelocque's description; the other representing the placenta and membranes preserving their normal relations, from Duncan. Duncan maintained that the inversion was produced by manual interference. This is undoubtedly true sometimes. But it is an error to assume that it is always true. We can affirm from the most minute observation that the uninterrupted natural process will often produce inversion of the placenta; and also that moderate traction on the cord, aided by compression of the uterus, will deliver a placenta edgewise, the membranes covering the fœtal surface.

Baudelocque's account is perfectly accurate. "Sometimes," he says, "the disunion begins at the centre of the placenta, and sometimes at a point of its circumference, and different phenomena result. In the first case, the middle of the placenta being pushed forward forms a pouch which fills with blood, and which presents to the touch its surface covered with membranes and vessels. A similar pouch forms, and the placenta presents in the same manner, when it begins to separate by the furthest edge from the os uteri. But things take place differently when the placenta is detached from below, especially when near the os. In this case it rolls upon itself like a cylinder or horn, according to the length of the uterus, so that it presents by its rough aspect, and its exit is always preceded by a discharge of blood." The case could not be better stated.

Tarnier affirms that the inversion of the ovum is habitually spontaneous, so that the amniotic aspect usually looks externally. The placenta, he says, first detaches itself, and in descending upon the neck of the uterus and into the vagina, it drags the membranes, which in their turn become detached; thus the ovum turns inside out like the finger of a glove, and presents its amniotic surface outwards. It is the fœtal surface then which usually presents itself at the orifice of the uterus, even when no traction is made upon the cord; but Tarnier also admits that the placenta sometimes presents by its edge. Ribemont-Dessaignes and Pinard, basing on numerous observations *ad hoc*, affirm that the placenta in the great majority of instances presents by its fœtal aspect. We conclude that both presentations may occur spontaneously; and we are prepared to go further and say, that the edge presentation, membranes covering the amniotic aspect, may occur under traction upon the cord. At the same time it must be admitted that traction upon the cord when the insertion is central favors inversion. The explanation, we think, will be found in the seat of attachment of the placenta. When the placenta is implanted upon the fundus, or anywhere within the upper polar region, the cord is usually central as regards the placenta, and the central detachment described by Baudelocque, leading to bulging of the middle of the placenta, most frequently takes place (see Fig. 115). On the other hand, when the placenta has grown to the sides of the uterus, a

part dipping within the lower zone or segment, this lower edge will genera be first detached and the placenta will descend edgewise, roll up lengthwi and come into the vagina with the membranes covering the fœtal aspect.

We offer this explanation, not as a matter of speculation, but as the res of many and careful observations upon the phenomena attending the vari seats of implantation of the placenta. These observations will be ag referred to when describing the history of placenta prævia. This view the mode of presentation of the placenta depending upon the seat of i plantation is described by Baudelocque. Figs. 115 and 116 represent the or

FIG. 115.

REPRESENTING FIRST STAGE OF SEPARATION OF PLACENTA FROM FUNDAL ATTACHMENT. COMMENCING INVERSION OF PLACENTA. (ROBERT BARNES.)

FIG. 116.

SECOND STAGE OF DETACHMENT OF PLACENTA FROM FUNDAL ATTACHMENT. INVERSION COMPLETE, DRAGGING MEMBRANES ON MATERNAL SURFACE. (ROBERT BARNES.)

nary mechanism of detachment and expulsion of the placenta when it ha grown to the upper region of the uterus; and Figs. 117 and 118, when it ha grown to the sides.

When the placenta is detached, the uterine contractions *drive it into th vagina*. If no interference be practised, this stage takes about ten to twenty minutes.

The next stage consists in the *expulsion from the genital canal*. This may take an hour or more. The recently distended vagina is expanded by the intruding placenta. It lies there beyond the range of uterine power; the vagina itself possesses inadequate contractile force; and but for the forcing action of the voluntary muscles exerted as in defecation, the placenta might remain for an indefinite time. Indeed, William Hunter and others of his school, carrying to extremes faith in the sufficiency of nature to complete a

physiological process, were in the habit of leaving the work to nature. The results were in some cases so disastrous by hemorrhage and septicæmia that this negative practice was abandoned.

There are four principal methods of managing the placenta. The *first* is the exploded one just described of doing nothing; but sometimes there is nothing to do. The *second* is that of removing it by hand from the uterus or vagina. The *third* is by expression, or squeezing the placenta out of the uterus or vagina by hand-pressure applied to the uterus. This is called

FIG. 117.

FIRST STAGE OF DETACHMENT OF PLACENTA FROM LATERAL ATTACHMENT. DESCENT EDGEWISE. (ROBERT BARNES.)

FIG. 118.

SECOND STAGE OF DETACHMENT OF PLACENTA FROM LATERAL ATTACHMENT, ROLLING-UP LENGTHWISE AND DESCENT EDGEWISE; MEMBRANES FOLLOWING ON FŒTAL SURFACE. (ROBERT BARNES.)

"placental expression." The *fourth* is by introduction of the hand into the uterus. These methods form an ascending scale, coming into successive use according to the rising necessity of the case.

If we are sure that the placenta is detached from the uterus, the *second plan*, which consists in simply withdrawing it by gentle traction upon the cord, aided by steady pressure on the fundus, is the best. *How do we know that the placenta is detached?* This may be inferred to have taken place if, after a few minutes' rest, pains or contractions of the uterus are felt by the patient; if the obstetrist feel the uterus harden and become sensibly reduced in bulk, forming a firm globe reaching not much above the umbilicus. Sometimes he may feel the uterus undergo sudden and considerable reduction in bulk, and he is sensible that something has passed out of its cavity.

The next step is to pass the index, the cord serving as a clew to search for the placenta. If he fail to reach the root of the cord and to feel the placen he may infer that the organ is not yet detached; if, on the

placenta be easily felt, it is because it is detached and has come down i the cervix or vagina.

Then comes the question of *removing* it. A common error is too gr haste to interfere. Wait a while for the uterus to recover power, and placenta to mould itself to the passages. If we begin traction too soon, irritated uterus is thrown into spasmodic action, the natural order of contraction is perverted; the placental seat, liable to a kind of paraly and the placenta, still perhaps partly adhering, is passive or only sligh contracting; more active contractions are provoked in the lower part of uterus. The effect of this is to imprison the placenta in a pouch at the up part of the uterus. It is "incarcerated," "encysted," or there is the so-cal "hour-glass contraction." And then, until the disordered action of the ute has been calmed by repose, or a dose of opium, or a whiff of chloroform- remedy to be avoided in this stage—the placenta will not come away, unl it be by the forcible introduction of the hand through the constricted part the uterus—also a proceeding to be avoided if possible; or, if we proceed remove the placenta whilst the uterus is still inert, we run great risk causing inversion.

Proceed then gently, and after a proper interval of rest, before trying remove the placenta.

Another imperative rule is *not to give ergot during the placental sta* Ergot given at this time is likely to defeat the very object in view. It likely to excite irregular spasmodic or tetanoid contractions, which will lo up the placenta, and render all attempts at manual extraction abortive, ev dangerous.

How to Remove the Placenta.

1. During the last stage of the expulsion of the child, the nurse or oth assistant will have been pressing steadily upon the fundus uteri, followi the child down.

2. Keep up gentle pressure upon the uterus after the birth of the chi Avoid kneading or rubbing the uterus, unless it be done very gently; oth wise this manœuvre is apt to cause disordered spasmodic action, and we h suspected it to be the cause of metritis.

3. After a repose of three or four minutes, holding the cord by one ha run a finger along it into the vagina. In this case two fingers may be firs pressed near the root of the cord into the body of the placenta, so as to h the placenta down towards the vulva. The pressure is steadily made ba wards, following the curve of the sacrum. You thus get by the combi use of the two hands "axis traction." At the same time moderate tract is made on the cord, and the whole mass is made to slide down. By consentaneous light traction on the cord, downward and backward press upon the placental mass, and steady pressure upon the fundus uteri by assistant, the distributed force avoids undue force in any one direction, the placenta, if detached, is removed in the easiest and safest man Nurses will often at this point urge the patient to cough or bear down, this may succeed. Harvey effected extrusion sometimes by giving a ster tatory. Pulling unduly upon the cord is apt to cause it to break away fr the placenta. The most common seat of rupture is near the inserti Hence we may infer that this is the weakest point. This accident ent the loss of the natural clew to the placenta, and renders it necessary to p the hand into the vagina, or even into the uterus to seize the placenta, un it can be squeezed out, as will be presently described.

4. As soon as the placenta is outside the vulva, seize it in both hands a rotate it two or three times, so as to throw the membranes into a twisted ro This gives them more cohesion, and the risk of leaving shreds behind lessened. Fig. 116 shows how the mass of the placenta protruding in vagi

or near outlet favors this rotation by the hands, and serves to draw the membrane down rope-form.

5. The placenta removed, steady pressure is still kept up on the fundus uteri, and the expelled clots and liquor amnii are received into diapers, or, better still, into a shallow bowl. The bottom of the sponge bowl answers well. This plan serves the double purpose of cleanliness and of enabling us to estimate the quantity and other characters of the discharge.

6. If the uterus is now felt contracted, firm "like a cricket ball," a broad binder may be applied. In the case of a primipara this may be enough, but in the case of a pluripara, in whom the abdominal walls are flabby and give little or no compressive force, a pad may be useful, so applied as to rest upon the fundus of the uterus, and be kept there by the binder.

When the placenta is expelled the uterus enters into permanent concentric contraction. The anterior wall of the body is compressed against the posterior wall, the fundus shrinks down upon the body; the lower segment also contracting, the whole organ regains something of its shape before pregnancy. It now resembles a pear flattened a little antero-posteriorly. Its cavity is now again triangular; into the two upper angles the Fallopian tubes open; the lower angle corresponds with the cervix. Normally, the juxtaposition of the anterior and posterior walls is so close that the cavity is obliterated; but owing to the forcible stretching which the lower segment and the cervix have undergone, partly paralyzing the muscular tissues, and tearing and bruising the cervix, especially at the os externum, this part remains flabby and open for a time; and not seldom that part of the uterus to which the placenta had grown is paralyzed for a while.

The fourth method, by passing hand into uterus.

If the placenta is not readily expelled or removed by the method described, we have to discover the cause of the delay:

1. The placenta may be wholly detached, and yet be retained in the uterus.

Simple Retention.—This may be due to want of contraction of the uterus. As has been already pointed out, for a few minutes the uterus, after the supreme effort of expelling the child, is exhausted; it wants repose to gather strength to expel the placenta. If the course of labor has been disordered, or if premature attempts are made to pull away the placenta, the uterus will contract irregularly: its polarity may be inverted, so that the lower segment contracting unduly, spasmodically, the placenta is shut up in the uterine cavity.

Hemorrhage commonly attends this condition.

2. The placenta may not be detached. Maintaining adhesion, partly or entirely, we then have *retention with adhesion*. The adhesion may be *natural or morbid*. In the case of partial adhesion, hemorrhage is almost certain.

We must not hastily conclude that the placenta is adherent. Adhesion is the bugbear of students and young practitioners. Practically it is very rare. It is a good rule in the first place to act as if it were not adherent, or as if the adhesion were only partial and easily overcome by the methods commonly used to expel the placenta, reserving the extreme measure of introducing the hand for those cases in which the common methods fail.

Assuming then the case in which the plan described in Section 3 fails, we may resort to "squeezing-out" or "expression."

Although long practised in Dublin, and precisely described by McClintock and Hardy in 1848, and in London by ourselves, in ways varying in detail, the name of Credé has of late years been especially associated with this manœuvre.[1] The proper way to squeeze out the placenta is to place

[1] The whole question of the removal of the placenta in its historical a
connections is fully discussed by Ribemont-Dessaignes, Thèse de Concours, 1

the patient on her back near the right side of the bed. You thus obtain perfect command over the uterus; you can use both hands to assist and relieve each other, avoiding unsteadiness and fatigue. The uterus is grasped by a hand applied on either side of the uterus, the balls of the thumbs resting upon the fundus. Then acting with spontaneous uterine contraction if it set in, or without if the uterus is paralyzed, concentric pressure is made by the hands. The uterus will tilt a little on one side, so that the anterior wall will be flattened upon the posterior—the normal condition of the empty uterus. In this way, regular contraction of the uterine muscle is promoted; its due polarity is restored by making the fundal action preponderate over the cervical action; its cavity is reduced in all its diameters; the placenta is driven out into the vagina, and by continuing pressure it is even shot out of the vagina into the bed. We trace this process going on by feeling the shrinking of the uterus under our grasp. The escape of the placenta from the uterine cavity is announced by a sudden reduction in bulk, and the escape of the placenta from the vagina is also felt by the operating hands. The process also is distinctly traced by the patient. The operation causes some pain, but should not on that account be done under chloroform or ether. These agents certainly counteract healthy uterine contraction and promote hemorrhage. The patient must exercise a little courage. The quick and effective relief compensates for her suffering.

Timely applied, "expression" aids and is aided by natural contractile effort. In this lies security. Expression as sometimes practised, by applying excess of pressure to the fundus, pushing it in towards the cavity, has caused inversion. See a case by Schnorr.[1] Johnston and Sinclair also relate a case.[2] A case of inversion which was admitted into St. George's (1881) under Robert Barnes's care, was produced in this way. Again, by unduly pressing the uterus down into the pelvis, retroversion has been caused. Both these serious accidents are avoided by following the method described.

A great advantage attending the method by expression is that it obviates passing the hand into the uterus. Dohrn demonstrated that the method was followed by bad results when practised immediately or very soon after labor. Fifteen minutes or more should elapse before resorting to it.

The placenta refusing to be squeezed out, we may assume that it is retained either (1) by *irregular contractions of the uterus*, including the so-called "*hour-glass contraction*," and preponderant contraction of the lower segment of the uterus, or (2) *by adhesion*. The term "hour-glass contraction" sometimes applicable, more often suggests a false picture. It is rare, indeed, to observe a case in which there is an annular constriction of the middle zone of the uterus dividing it into two cavities, the upper one containing the placenta, the lower one relaxed and freely open to the vagina. The more common condition is that in which the placenta is shut up, "encysted," in a chamber formed near the fundus by a spasmodic contraction of all that part of the uterus which lies below the region of the placental site. This condition arises from a combination of two factors: (1) the muscular wall corresponding to the placental site is paralyzed instead of being the centre of active contraction; (2) the lower part of the uterus, which ought to be comparatively inert and yielding, contracts unduly and spasmodically. There is reversed polarity. This condition is commonly brought about by pulling upon the cord, or by other treatment which disorders the proper sequence of the factors of labor. Hemorrhage often attends.

To meet this difficulty it is well in the first place to allay disordered

[1] Monatsschr. f. Geburtskunde, 1867. [2] Practical Midwifery.

nervous action by sedatives. Twenty or thirty drops of laudanum, with twenty of tincture of digitalis in camphor water, may be given. If the patient is unusually weak, it is better to inject sixty minims of pure ether under the skin, or make her breathe a few drops of nitrite of amyl. The patient is then brought to the edge of the bed, on her left side. The operator then grasping the fundus uteri in his right hand applied above the pubes, introduces his left hand into the vagina, and making his fingers into a cone-form passes them through the os uteri until he arrives at the constriction. Then by steady sustained pressure, aided by downward pressure on the fundus, the resistance is overcome. This is not to be done by violence, but

FIG. 119.

REPRESENTING MANUAL REMOVAL OF PLACENTA. (ROBERT BARNES.)
Left hand in the uterus peeling placenta from its attachment. Right hand externally pressing fundus upon left hand.

by sustained pressure, on the principle of tiring out the muscular spasm. The constriction passed, the fingers may be opened to grasp the placenta. Endeavor to begin with an edge, so as to glide the fingers between the placenta and uterus, detaching it if it adheres. Holding the placenta, by consentaneous drawing-out, and external compression, the placenta is removed. In this proceeding the external compression should be the preponderating force. (See Fig. 119.)

Being assured that the uterus is well emptied, compression should be still kept up on the uterus until it is thought proper to apply pad and binder.

If the placental retention be due to *adhesion*, the proceeding just described is to be followed out. In most cases the adhesion is not due to abnormal tissue, and the separation is easily and completely effected by pressing the fingers on between placenta and uterus. In some cases, however, the adhesion is so intimate that it is difficult to feel where placenta ends and uterus begins. In such a case it is easy to be over-zealous. The safer rule, long ago pointed out by F. Ramsbotham, is to detach all that can be detached without violence, and by passing the tip of the finger into any projecting masses to break them up, to destroy their active vascular connection with the uterine wall. This done, the great immediate object of removing t active cause of hemorrhage is accomplished, and you avoid dan

[illegible] surrounding the uterus. After such an operation it is desirable to wash out [illegible] uterus with hot carbolized water in the proportion of 1 in 50.

We must be prepared to find pieces of placenta now and then coming away after this operation, and for the reproaches of attendants and gossips, ever ready to blame the doctor who "left some of the after-birth behind." These we must bear with equanimity, content if we have done our best to bring it away safely, not rupturing the uterus or setting up metritis, and taking care by appropriate after-treatment to obviate any ill-consequence that may arise from the imperfect operation.

This after-treatment is important. (1) There is the washing-out with carbolized water; (2) the administration of quinine and ergot to keep up contraction of the uterus; (3) if hemorrhage return soon, inject hot water, then solution of iodine, and, if that fail, perchloride of iron. If hemorrhage should recur after two or three days, anæsthetize the patient, and pass the fingers into the uterus for another attempt to remove the portions left adhering. They may now yield more readily before the fingers. In some cases we have successfully employed the wire-écraseur, treating the projecting masses like polypi. Indeed, they have been not inappropriately called "placental polypi." The wire is perfectly safe, it cannot dig into the uterine substance; it simply shaves off the projecting masses [illegible].

The placenta delivered, we come to the post-placental period.

We have now to consider how to dispose the patient to make her comfortable and safe before leaving. The first point to determine is the application of a binder. To apply a binder properly, the patient must be laid upon her back, with the legs extended. In this position the operator has complete command over the uterus, and the binder embracing the hips well ensures uniform effective support, and is less likely to ride up and become loose.

Tyler-Smith says[*] "women have died suddenly for no other reason than that the binder was omitted."

It is an excellent plan to apply a temporary binder during the second stage of labor, tightening it according to [illegible] as the uterus and abdomen become smaller. This [illegible]. The diffused support given to the abdominal walls is of [illegible]. The pressure upon the uterus keeps the axis of [illegible] to the axis of the pelvis; it [illegible] contraction of the uterus; it maintains due tension of the abdominal [illegible]; it gives a sense of comfort and power to the woman; and it [illegible] of the permanent binder. This plan further [illegible] in the lateral or English decubitus of the [illegible] that it allows the uterus and abdomen to [illegible]. It is especially useful in pluriparæ. In [illegible] who preserve good nerve and muscle, [illegible] expulsion of the placenta is steadily [illegible] pain, except, perhaps, a sense of soreness and fatigue. [illegible] of weak fibre, when the nervous system is [illegible], the uterus, after having contracted, may relax again, [illegible] contractions, not in [illegible], but in a [illegible] manner. These contractions are attended by pain—"after-pains." The [illegible] of the pain is found in the circumstance that [illegible] of blood into its cavity, [illegible] spasmodic contraction, [illegible] pain. The condition is analogous to [illegible].

A second cause of after-pains [illegible].

[*] [illegible]

e been emptied during the labor, but not seldom it becomes
paralyzed, and filling, irritation causing reflex spasmodic con-
t up. This irritation may be propagated to the uterus.
use, often unsuspected, is *retroversion or retroflexion of the uterus.*
and flabby, the fundus easily falls back, or is thrust back under
œuvres, during and after the extrusion of the placenta. E.
erlin, also showed that retroversion, post partum, was favored
ta having grown to the posterior wall of the uterus. This part,
l thicker and heavier, falls back. In like manner, attachment
ta to the anterior wall favors anteversion, and also "after-
combined distortion and malposition impede the circulation
terus, lead to congestion and hemorrhage, and the retention of
vity; hence "after-pains."
ving the patient, observe the aspect of her face, feel the pulse,
men, *look* at the vulva to see if there be any trickling of blood.
ains of feeling faint, shows marks of undue depression, says she
rge coming from her, and this is confirmed by examination; if
enlarges, undo the binder, pass the catheter, compress the uterus
hands to expel clots. The treatment now is that for hemor-
will be specially considered in another chapter.
he placenta to see that it is entire, and to take note of any
dition.

E CORD.—When the child is born, the question of tying the
It has been contended that tying the cord is superfluous, and
f the lower animals has been cited in proof. It is true that
ld breathes the immediate effect is to turn the current of the
to new channels and to divert it from the placenta, and there-
umbilical cord. It is also true that when the cord is divided,
it, there is a spontaneous retraction of the umbilical arteries
ssues of the cord, and such a diminution of their calibre that
commonly be prevented. Ribemont-Dessaignes has carefully
s anatomical arrangement. P. Dubois, Depaul, and others
us observations to test the necessity for tying the cord. They
a great number of cases no bleeding followed simple division.
ints out that in all these experiments the aërial respiration was
ed *before* the cord was divided. And we may add that in cases
e had occasion to cut the cord before applying a ligature, and
ild has breathed, bleeding has taken place; and in some cases
ligature was not tied tightly enough, bleeding has taken place
after the child had breathed freely. Similar facts must be
ry experienced obstetrist.
l to comparative parturition is not free from fallacy. Animals
ord with their teeth, or stamp upon it, to effect separation. The
is similar to that of torsion of arteries. To imitate this, it has
ended to use blunt scissors. The idea is not without value. But
tie. It would not be pleasant for the obstetrist, nor conduce to
n, to be called back to the lying-in chamber to find the child
leath.
then full force to the anatomical and physiological provisions
rrhage, no one at the present day would omit the precaution of
d on the child's side of the point of division.
ord must be tied, what is the right time for doing it? Some prac-
the cord immediately after the child is born, others wait till
no longer felt in the cord; others, again, wait until t
eathed.

of wounding the uterus. After such an operation it is desirable to wash out the uterus with hot carbolized water in the proportion of 1 in 50.

We must be prepared to find pieces of placenta now and then coming away after this operation, and for the reproaches of attendants and gossips, ever ready to blame the doctor who "left some of the after-birth behind." These we must bear with equanimity, content if we have done our best to bring it away safely, not rupturing the uterus or setting up metritis, and taking care by appropriate after-treatment to obviate any ill-consequence that may arise from the imperfect operation.

This after-treatment is important. (1) There is the washing-out with carbolized water; (2) the administration of quinine and ergot to keep up contraction of the uterus; (3) if hemorrhage return soon, inject hot water, then solution of iodine, and, if that fail, perchloride of iron. If hemorrhage should recur after two or three days, anæsthetize the patient, and pass the fingers into the uterus for another attempt to remove the portions left adhering. They may now yield more readily before the fingers. In some cases we have successfully employed the wire-écraseur, treating the projecting masses like polypi. Indeed, they have been not inappropriately called "placental polypi." The wire is perfectly safe, it cannot dig into the uterine substance; it simply shaves off the projecting masses smoothly.

The placenta delivered, we come to the *post-placental period.*

We have now to consider how to dispose the patient to make her comfortable and safe before leaving. The first point to determine is the application of a binder. To apply a binder properly, the patient must be laid upon her back, with the legs extended. In this position the operator has complete command over the uterus, and the binder embracing the hips well exercises uniform effective support, and is less likely to ride up and become loose.

Tyler-Smith says[1] "women have died suddenly for no other reason than that the binder was omitted."

It is an excellent plan to apply a temporary binder during the second stage of labor, tightening it according to indications as the uterus and abdomen become smaller. This need in no way impede manipulation. The diffused support given to the abdominal walls is of material assistance. The pressure upon the uterus keeps the axis of uterus and child in due relation to the axis of the pelvis; it promotes steady contraction of the uterus; it maintains due tension of the abdominal vessels; it gives a sense of comfort and power to the woman; and it facilitates the adjustment of the permanent binder. This plan further obviates the principal objection made to the lateral or English decubitus of the parturient woman, namely, that it allows the uterus and abdomen to bag down away from the pelvis. It is especially useful in pluriparæ. In healthy primiparæ, and in many pluriparæ who preserve good nerve and muscle, the uterine contraction following expulsion of the placenta is steady and persistent, and there is little or no pain, except, perhaps, a sense of soreness and fatigue. But when the patient is of weak fibre, when the nervous system is unduly mobile, the uterus, after having contracted, may relax again; and there is a tendency to the recurrence of contractions, not in strict rhythm, but in a disorderly manner. These contractions are attended by pain—"after-pains." The explanation of the pain is found in the circumstance that the relaxing uterus favors an *outpouring of blood into its cavity*, which, *clotting*, excites reflex action; and the induced spasmodic contraction, not easily expelling the clots, causes pain. This condition is analogous to dysmenorrhœa from retention.

A second cause of after-pains is *distention of the bladder.* This organ will

[1] Manual of Obstetrics.

probably have been emptied during the labor, but not seldom it becomes temporarily paralyzed, and filling, irritation causing reflex spasmodic contractions is set up. This irritation may be propagated to the uterus.

A third cause, often unsuspected, is *retroversion or retroflexion of the uterus.* When bulky and flabby, the fundus easily falls back, or is thrust back under obstetric manœuvres, during and after the extrusion of the placenta. E. Martin, of Berlin, also showed that retroversion, post partum, was favored by the placenta having grown to the posterior wall of the uterus. This part, thus rendered thicker and heavier, falls back. In like manner, attachment of the placenta to the anterior wall favors anteversion, and also "after-pains." The combined distortion and malposition impede the circulation through the uterus, lead to congestion and hemorrhage, and the retention of clots in its cavity; hence "after-pains."

Before leaving the patient, observe the aspect of her face, feel the pulse, feel the abdomen, *look* at the vulva to see if there be any trickling of blood. If she complains of feeling faint, shows marks of undue depression, says she feels a discharge coming from her, and this is confirmed by examination; if the abdomen enlarges, undo the binder, pass the catheter, compress the uterus firmly by the hands to expel clots. The treatment now is that for hemorrhage, which will be specially considered in another chapter.

Examine the placenta to see that it is entire, and to take note of any abnormal condition.

Tying the Cord.—When the child is born, the question of tying the cord arises. It has been contended that tying the cord is superfluous, and the practice of the lower animals has been cited in proof. It is true that when the child breathes the immediate effect is to turn the current of the circulation into new channels and to divert it from the placenta, and therefore from the umbilical cord. It is also true that when the cord is divided, without tying it, there is a spontaneous retraction of the umbilical arteries within the tissues of the cord, and such a diminution of their calibre that bleeding will commonly be prevented. Ribemont-Dessaignes has carefully described this anatomical arrangement. P. Dubois, Depaul, and others made numerous observations to test the necessity for tying the cord. They found that in a great number of cases no bleeding followed simple division.

Tarnier points out that in all these experiments the aërial respiration was well established *before* the cord was divided. And we may add that in cases where we have had occasion to cut the cord before applying a ligature, and before the child has breathed, bleeding has taken place; and in some cases in which the ligature was not tied tightly enough, bleeding has taken place some hours after the child had breathed freely. Similar facts must be known to every experienced obstetrist.

The appeal to comparative parturition is not free from fallacy. Animals lacerate the cord with their teeth, or stamp upon it, to effect separation. The effect of this is similar to that of torsion of arteries. To imitate this, it has been recommended to use blunt scissors. The idea is not without value. But it is safer to tie. It would not be pleasant for the obstetrist, nor conduce to his reputation, to be called back to the lying-in chamber to find the child bleeding to death.

Granting then full force to the anatomical and physiological provisions against hemorrhage, no one at the present day would omit the precaution of tying the cord on the child's side of the point of division.

Since the cord must be tied, what is the right time for doing it? Some practitioners tie the cord immediately after the child is born, others wait till pulsation is no longer felt in the cord; others, again, wait until the child has fairly breathed.

The immediate ligature ought to be abandoned. There are physiological and clinical reasons for waiting until respiration is set up. Budin instituted experiments at the Paris Maternité, under the direction of Tarnier, to illustrate this point. When the cord is divided immediately, the quantity of blood poured out from the placental end is notably greater than when the division is made after the cord has ceased to pulsate. Now the question arises: What becomes of the excess of blood when the cord is tied at the later period? It passes into the circulation of the child. So Hélot and Schüking[1] showed that when the cord was left untied, adhering to the placenta still *in utero*, weighing the child immediately after birth and again after the cord had ceased to beat, they found the child had gained sensibly in weight.

Against immediate ligature there is the further argument that the placenta may still be in vascular relation with the uterus, and that the child depends upon this relation until it breathes.

Our own practice has been to wait until the child breathes, or at any rate until the cord ceases to pulsate. Usually when the child breathes, the pulsation in the cord stops. But occasionally the cord ceases to pulsate before the child breathes. In this case there is nothing to be gained by further delay. The animation of the child is more certainly achieved by removing it from the bed to practise the necessary manœuvre. The plan to adopt is this: When the child is born, turn it on its back; clear away discharges, membranes, and anything that may obstruct respiration, from its mouth and chest; let it lie in the bed until it breathes and cries freely. Observe the cord: at first turgid, purple, pulsating strongly, it gradually shrinks, becomes pale and flaccid, the pulsations become feeble or stop. The ligature may now be applied. One is enough. There is no good reason for applying a second ligature on the placental side.

How to Tie the Cord.—At what point is it best to tie it? The usual practice is to tie at about two or three inches from the umbilicus. The best material is stout thread, doubled four or five times. It is better waxed, so as to make it bite more tightly. The ligature is passed in two circles round the cord, and then tied in a double knot very tightly, so as to bury the ligature in the Whartonian jelly. This is most surely effected by tightening the ligature slowly. Notwithstanding every care, the ligature will occasionally get loose from the shrinking of the mucous tissue of the cord. Hence the necessity for examining after an interval of half an hour or more.

Tarnier contrived a special plan to insure obliteration of the vessels. He applied a match-stick parallel to the cord, then the ordinary ligature, and then an elastic ligature. Budin made experiments which proved that the elastic ligature is the most efficacious. Dr. Dickson had in 1876 made use of an elastic ligature.

Sometimes the cord is torn off accidentally on a level with the umbilicus. In such cases we have passed a fine needle through the stump, and twisted a silk thread in a figure-of-eight round it. A similar proceeding may be required when bleeding follows the falling of the cord, as sometimes happens.

This done, the child is received in a flannel and given to the care of the nurse.

[1] Zur Physiologie der Nachgeburtsperiode, etc., 1877.

CHAPTER XVI.

THE PUERPERAL PROCESS, OR THE NATURAL HISTORY OF CHILDBED.

THE transition from gestation and labor to puerpery is marked by (1) sudden diversion of blood-flow from the pelvic vascular system. The current is turned back upon the general system; hence, according to Marey, temporary increase of vascular tension. This diversion is analogous to and coincident with the equally sudden diversion of the child's blood from the placenta on tying the cord.

2. The developmental force which hitherto attracted blood-flow to the pelvis is suddenly arrested.

3. This diversion of the blood-flow is effected by contraction of the uterus, at first active, then tonic, which, compressing the uterine vessels, bars them against the entry of blood into the arteries.

4. Changes are wrought in the system. Cessation of pain and nervous tension.

5. A vacuum is produced tending to pump in air, unless the abdominal walls are endowed with extraordinary vigor, muscular and elastic, to retract and obliterate the space left by the emptied uterus. This sudden loss of support or natural pressure upon the intestines, and through this upon the uterus, vena cava, abdominal aorta, and liver, further takes off the natural tension of the vessels, and disturbs the action of the heart, disposing to syncope and thrombosis.

This vacuum-action is proved by the observation during labor of the recession of the presenting head as the pain goes off; it is felt and measured by the forceps which, previously adjusted, is drawn up into the pelvis between the pains. During craniotomy we may feel and hear air sucked into the cranium during remission of expulsive action, and driven out when the expulsive action is renewed.

The mechanism that favors the indraught of air also favors the entry of noxious fluids into the uterine sinuses.

Hence the necessity for the twofold and associated security obtained by supporting the abdominal walls and obtaining contraction of the uterus. This is the first point in antiseptic midwifery.

The uterus is stimulated to contract by pressure upon its fundus, as by the hand; and through the abdominal walls by a bandage.

The transition from the state of gestation to that of childbed, effected by labor, is attended by a great systemic revolution. The system is no longer dominated by the fœtus. A special condition of the system had been developed in order to carry out the process of gestation. That process completed—and it is completed abruptly—the special conditions of gestation abruptly cease, and a new *régime* is established. The gestation process also calls forth a special development of certain organs, raising them to a state of physiological hypertrophy. The purpose of this special development accomplished, these organs at once enter upon a process of so-called involution, or return to the ordinary condition of non-gravidity.

We have thus two orders of phenomena to observe—*the general and the local.*

A. The *general phenomena.* The most striking of these relate to the

functions of innervation, of the circulation, of respiration, of nutrition, of secretion and excretion, and to the attendant changes in the organs which perform these functions.

B. The *local phenomena* relate to the functions of the generative organs and the changes effected in them.

The general and local phenomena must of necessity be described one by one; but it is essential to follow up this analytical study by a mental synthesis, bringing them all together in solidarity. They are physiologically links in a circular chain; all are interdependent. If the harmonious relation of these general and local functions and changes is disturbed, then the whole puerperal process is disordered, and a physiological state merges into a quasi-pathological state.

The same forces will continue to act, complicated, perhaps by the intrusion of foreign influences. The right appreciation of the diseases of the puerperal woman, then, must rest upon the foundation of accurate knowledge of the healthy puerperal process. Here the definition of pathology started by Robert Barnes finds an appropriate illustration: "Pathology is Physiology struggling under difficulties."[1]

Among the general post-partum phenomena the most striking is the rapid fall in nervous and vascular tension. The process of structural building is suddenly arrested; the nervous energy accumulated for the tremendous act of labor is expended. A new order of things is established. Instead of building, demolition has to be effected. The hitherto constantly increasing increment of tissue and fluid elements is not only suddenly stopped, but the accumulated material has to be rapidly got rid of. The physiological energies are reversed. Active nutrition gives place to active absorption and excretion. Endosmosis predominates over exosmosis.

We may form an idea of the magnitude of the revolution that takes place at the moment of the completion of labor, and of the work that has to be subsequently done, by studying the facts stated by Gassner, showing the loss of weight undergone after labor.[2]

Admitting that these observations are nearly true, we may deduce some instructive applications.

1. The parturient woman almost suddenly loses about 10 per cent. in weight of the solids and fluids which up to the moment of delivery formed part of her organization.

2. This tenth part being of about equal specific gravity with the rest of the organism, occupied proportionate space. And this cast out tenth part was almost wholly contained in the abdominal cavity.

Within an hour then, or less, the body has lost one-tenth in weight and one-tenth in volume. A change so great, and so rapid cannot fail to be attended by corresponding changes in the processes of nutrition, chemical, and mechanical. The sudden separation of the child and placenta may be likened to an amputation at the hip-joint. Certainly there are wide differences in the subsequent conditions; but we shall have to refer presently to one or two points of great analogical interest.

The first effect is *shock*. An impression more or less profound is made upon the ganglionic, cerebral, and spinal centres. In most instances this shock is an entirely healthy phenomenon. A transient stage of depression, not amounting to exhaustion, is soon followed by a sense of relief, even of restored power, of happiness. In other cases the depression is more serious. The nerve power is exhausted; it is not duly recruited; the heart flags or fails altogether; the spinal cord and the brain are partially paralyzed. The

[1] Lancet, Clinical Lectures.

[2] See vol. i.

blow may be so heavy that life may be extinguished. This is one of the causes of sudden death in childbirth. Between the beneficent physiological shock and the shock that kills, there are degrees varying with the severity of the labor and the power of the woman. These intermediate degrees of shock are marked by syncope, by hemorrhage, or other more or less dangerous symptoms.

2. After shock comes *reaction*. After healthy shock the process subsequent upon labor are carried out in safe and regular order. The reaction that ensues upon the severer intermediate dégrees of shock is fitful and disorderly; the nervous influence is unequal to maintain the due control, to regulate uterine action and the work of the circulation. The physiological balance is disturbed, the blood-mass is almost surely affected in quantity and quality; the absorbent and secreting organs are therefore disturbed in their work.

Hence, we often see after severe labors that the puerperal process is disordered. We trace back then to the labor-shock many cases of puerperal disease.

We may first take note of the more purely mechanical influences. When tracing the history of gestation we cited the description of De Cristoforis[1] of the mechanical disturbances induced by the gravid uterus. He contends that the uterus pressing upon the abdominal aorta and iliac veins and inferior vena cava causes (1) superior arterial hyperæmia, with increased heart-tension and hypertrophy; (2) inferior venous hyperæmia. Now, the sudden diminution in bulk of the uterus is followed by the liberation of the abdominal vessels from obstruction. There will be an instantaneous tendency of the superior arterial hyperæmia to subside, the supply of arterial blood to the head will be lessened, the venous blood and serum arrested in the lower extremities will flow unimpeded towards the abdomen. Hence, two dangers: syncope, due to the sudden diminution of blood in the brain, and the perturbation of the heart under shock; and hemorrhage from the uterus, due to the free rush of blood to the vacated region of the abdomen and the lowering of tone under the shock. The normal counteracting or compensating provision against these dangers is mainly the firm contraction of the uterus. If this prevail, the circulation is quickly restored to its equilibrium and adapted to the new *régime*. The heart-tension is maintained.

Concurrently with these mechanical factors another factor exerts a powerful influence upon the circulation.

From the moment that the placenta is cast, the developmental energy, which had hitherto irresistibly attracted large volumes of blood to the uterus, ceasing, the blood-current is turned off. This is the negative factor. The positive factor is seen in the contraction of the uterus, whose interlacing fibres constrict the bloodvessels and refuse admittance to the blood. The blood is called elsewhere. A new focus of developmental energy is set up in the breasts, and the vessels supplying these organs undergo a physiological hypertrophy. The breasts have superseded the uterus; the child has shifted the source whence it draws its sustenance. But the full establishment of the activity of the new developmental focus is rarely effected until the third day. To this first or mechanical process succeeds

[1] See vol. i.

The Involution Process.

This may be defined as *the process by which the uterus and other organs are reduced or brought back to the ordinary condition of non-gravidity. Regression*, then, would be the more correct term.

But preceding the removal of the superfluous solid tissue, there takes place a rapid absorption and removal of serum which has been exuded into the connective tissue of the lower limbs especially and of the pelvis. The œdema of the legs had mainly arisen during pregnancy; the œdema of the pelvis had been partly formed during pregnancy, but a larger part was the direct effect of labor. The lining membrane of the parturient canal had been partially detached from the subjacent tissues under the influence of friction by the advancing head. Hence extravasation not only of serum, but commonly of blood also. As soon as the pressure of the gravid uterus upon the pelvic veins, and the developmental turgor are taken off, the fluids in the connective tissue are quickly removed. The rapid entry of these fluids into the circulation probably helps to keep up vascular tension.

Then succeeds the true involution-process. The new tissue which had been formed in the uterus, heart, bloodvessels, liver, spleen, and probably in the nervous system, to subserve the nutrition and development of the fœtus and its extrusion, now superfluous, have to be got rid of. The process by which this superfluous material is thrown out of the system consists of several parts: the first is the conversion of the solid tissue into a fluid which can be taken up by the lymphatics and venules. This conversion consists in fatty metamorphosis. Being a strictly physiological change, the term "degeneration" commonly applied is incorrect. The change has been most accurately studied in the uterine muscular tissue; but that the same change is undergone by the waste tissues elsewhere cannot be doubted. The liquefied tissues form what Virchow happily called "physiological milk." In this state they are fit for absorption. This is effected in the case of the uterus by the lymphatic vessels and venules of the pelvic region. That part of the fluid which is taken up by the lymphatics undergoes the influence of the lymphatic glands; that part which is taken up by the venules undergoes the influence of the liver especially, before entering the circulation. Carried to the heart and thence to the lungs, further changes are effected. Some of its elements are there eliminated; and to this aërial elimination is partly due the peculiar smell to which the term "*gravis odor puerperii*" is given. Carried on into the systemic circulation it is brought to the great glandular excreting system. The chief component parts of this system are the kidneys, the glands of the intestines, and the skin. The liver and the lungs, which came primarily into action, come in also secondarily with the other glandular organs. All work in solidarity. The process of involution, and therefore of absorption and excretion, is not actively established before the second or third day after labor. The granular metamorphosis of the new tissue necessarily takes some time. During the first two or three days the vascular tension is still high; and it may be stated as a physiological law that *so long as high tension prevails absorption is slow.* It is interesting to observe that the starting of involution and absorption is nearly coincident with the starting of the secretion of milk; and also that the first milk secreted during the early period of absorption differs in quality from that which is secreted later, when the ordinary equilibrium of nutrition is restored. The breasts then may be looked upon not simply as organs constructed to supply nourishment to the infant, but also as special organs of excretion, helping involution.

How Long does the Involution Process go on?—The involution of the uterus is in great part effected within seven or eight days; but it may be broadly stated that the process is rarely completed in less than a month. The course of involution admits of fairly precise observation. The uterus may be measured day by day by the sound. By measurements thus taken Robert Barnes has found the uterus from os externum to interior of fundus to be nearly three inches at the end of a week, and at the end of the fourth week to be barely more than 2½ inches, the ordinary length of the non-pregnant uterus. Looking to the uterus, the organ of prime importance, and which lends itself most freely to precise observation, it may be stated approximately that the uterus has to be reduced from two pounds, its weight immediately after labor, to two ounces, or a little more, its ordinary weight in the non-pregnant state. It must be remembered that the uterus which has been once developed under the influence of gestation rarely returns to the weight or size it possessed before impregnation. The sound may indicate in both cases a length of 2½ inches, but the cavity only is thus measured, and the sound alone takes no measure of the thickness of the walls. The walls retain a certain degree of hypertrophy. The fundus between the origins of the tubes is now convex instead of flat. This increased thickness of convexity may generally be felt by the hand applied above the pubes, whilst the uterus is supported on the sound.

Tarnier estimates that the weight of the uterus after the placenta is cast out varies from 900 to 1500 grammes.

Spiegelberg states the average weight to be about two pounds, and that two days after labor it is only one pound and three-quarters; after the first week it is reduced to one pound; after six weeks or two months it is only 40 to 60 grammes, that is the weight of the non-gravid uterus.

Hecker has made some analogous observations. Conclusions drawn from weighings of the uterus are open to the obvious objection that a process which requires health for its performance can hardly be judged by observations made upon uteri in which that process had been disordered by fatal disease. Measurements by the sound in living healthy women are more trustworthy. Following this method, Robert Barnes has arrived at the conclusion that the regression of the uterus is more rapid than that indicated by the balance.

Dr. Sinclair, of Boston,[1] gives tables of measurements made in puerpery. He found that in some cases the uterine cavity measured 2.50 in. or less in from 14 to 21 days. In one series of observations the cavity measured on the 16th day 3.50 in., and in a second series on the 20th day 3.80 in. In these two series there had been laceration of the cervix. It may be concluded that this has a retarding influence.

Dr. Milsom, at the Lyon Hospital, measured a large number of uteri from the day of delivery. Twelve hours after labor the uterus was 13.50 cm. above the pubic plane, on the 11th day it had fallen to 5.50 cm. above this plane. On the 4th day the uterine cavity measured 14 cm., on the 11th day 10 cm. During the first three days the diminution is more rapid than at a later period. Involution is slower in the cervix than in the body of the uterus. He says involution is retarded by suckling. It is a little quicker in multiparæ than in primiparæ. It is more pronounced in women who have not suckled.

The measurements found by ourselves are less than those of French and German observers. Accepting the data of these observers we should conclude that involution takes five or six weeks or more for completion. But

[1] Gynæcological Transactions, 1882.

it must be noted that their observations are all, or nearly all, taken in lyin in-hospitals. Influences prevailing in these institutions retard the involutio process; conclusions drawn from this source cannot safely be applied to t healthy puerpera delivered under sound hygienic conditions.[1]

We think it right to protest, in the interest of the woman, against indi criminate resort to uterine measurement in childbed. It can hardly b practised without some risk of disturbance of mind and body at a time whe rest is above all thing needed. We know that it is followed at times by hig temperature; it is apt to favor the entrance of air into the vagina and uteru and thus, and in other ways, to increase the risks of septicæmia.

The Process of Involution or Regression.—1. We may first examin the *extraplacental surface*. After labor this is generally covered with clot When these are removed, the internal surface is seen red, rough, jagge Colin calls attention to small yellowish spots resembling the caduca whi was cast off with the chorion to which it adhered. These are simply t remains of the caduca adhering to the muscular coat. From their surfa little shreds project by their free ends into the uterine cavity. At the lo part of the uterine cavity the mucous membrane terminates by a well-mark jagged border which marks distinctly the line of separation from the mucous membrane of the cervix which remains adherent to the muscu coat. Shreds of the mucous membrane of the cavity of the body are a seen floating in the cervix.

On scratching the surface of the cavity of the body of the uterus, a la 1 mm. or 2 mm. thick, thicker as we approach the middle and fundus of t uterus, is detached. This layer is reddish-gray, friable, torn like a pseud membrane of recent formation. It is very vascular. Beneath it is th muscular coat, white or grayish, easily distinguished by its clearer colo its fibrillar texture, and its greater firmness.

The portion of the parietal decidua which remains adherent is compose of interglandular tissue, and remains of glands, especially numerous in the neighborhood of the muscular coat.

The bloodvessels, the lymphatic vessels, and spaces of the interglandular tissue are widely open, and communicate with the uterine cavity. These vascular reservoirs form a kind of open gates through which absorption of septic matters may enter.

These structures undergo *fatty degeneration* and *expulsion;* then there is a process of *regeneration* of a new mucous membrane.

2. *The Placental Surface.*—This presents a prominent, rounded, uneven, lobular mass, standing out from the surrounding surface. The internal surface shows the trace of separation from the placenta; it is called the *placental wound*. Robin says it is formed by the utero-placental mucous membrane remaining adherent, all but the thin superficial layer which had been torn away by the placenta.

The retraction of the uterus taking place after labor greatly reduces the extent of the bulging area formed by the serotina. Circular during pregnancy, it becomes oval, its long diameter being in the longitudinal direction of the uterus. But it gains in thickness. Some days after labor, the surface becomes folded, rough, as if lobular. Its tissue is brownish-red; it softens by degrees, becoming pulpy. The irregular, jutting edges are continuous with the mucous membrane which covers the rest of the uterus. It undergoes a similar process of regression to that which takes place in the decidua elsewhere.

Venous thromboses form at the level of the serotina; that is, clots are

[1] See Tarnier, p. 766.

formed in the vessels of the serotina and in those of the muscular wall. On the surface of the placental site we may often see the mouths of vessels blocked by red or pale clots. If these clots are followed up into the thickness of the mucous membrane, we soon come to the subjacent uterine sinuses. We are struck by the cavernous aspect which the anastomoses give to this layer; and we may note that the prominences made on the uterine surface are due principally to the blood-clots which fill and distend the sinuses.

The thrombi which result from the slowing and finally the stagnation of the blood in the veins of the mucous and muscular coats in consequence of the regression of the uterus are not all produced at the same time. Thus at the seventh day after labor, we may find permeable vessels, not altered, without trace of thrombus, by the side of other vessels obliterated either by recent thrombi, or by thrombi five or six weeks old, and therefore dating from a month or more before labor.

Friedländer and Leopold have described a *spontaneous venous thrombosis* as produced during the later stage of gestation. The veins of the muscular coat and of the serotina are the seat of this thrombosis. The giant-cells of the serotina exist in groups and tracks, the length of the venous channels. At the end of gestation, from the eighth month, especially at term, these cellules are seen to penetrate into the walls of the sinuses, to part their endothelial elements, and thus to project into the calibre of the vessels, where they cause coagulation of the blood. Thus, a part of the venous sinuses corresponding to the placenta are already at term blocked by the giant-cells of the serotina, coagulum, and young connective tissue, so that the circulation in the veins is impeded. As we have seen, it is this process that Leopold assigns as the cause of the commencement of labor.

Thus, according to Leopold, the uterine mucous membrane is regenerated at the end of six weeks. At this time it is pierced on its surface by numerous small points representing the orifices of glands, and a superficial capillary network which plays an important part in menstruation. The placental site may remain raised above the general surface for a considerable time after labor. It thus constitutes important evidence of past pregnancy. The obliterated vessels disappear by fatty metamorphosis, sharing in the process of involution which seizes upon the muscular coat.

The State of the Neck of the Uterus after Labor.—During labor, and especially during the expulsion of the head, the neck of the uterus is exposed to enormous, even violent, distention. A process occurs to which in our opinion sufficient attention has not been drawn. The friction produced by the on-driven head naturally tells most upon the structures with which it is in immediate contact; they are the mucous membrane and the immediately subjacent tissues. At the same time the external wall of the lower segment of the uterus and cervix is partly supported, held back by the adnexa—that is, by the broad ligaments, the base of the bladder, the reflection of the vagina, and the pelvic fasciæ. The consequence is that the mucous membrane or tissues more immediately in contact with the head are carried down by a glacier-like action over the subjacent tissues. This movement is more marked on the anterior lip. Hence these phenomena ensue: (1) bruising, contusion of the superficial layers of the mucous membrane; (2) disruption of the smaller vessels running in the deeper layers of the mucous membrane and the superficial layers of the muscular coat; (3) hence, submucous hemorrhage; (4) the whole cervix carried down is attended by great stretching, elongation, even laceration, of the connective tissue in the neighboring parts of the broad ligaments, and in that immediately surrounding the cervix uteri; the consequence of this is some amount of hemorrhage, always œdema.

In addition to this injury from contusion, there is almost invariably *laceration of the edge of the os externum.* This laceration most commonly takes place in the left side of the os—that is, on the side which had to encounter the violent impulse of the broad firm occiput of the fœtal head. This remains after childbed; it hardly ever heals completely; it is partly restored by cicatrix; but not uncommonly the os externum remains fissured down to the angle of vaginal reflection.

The proof of the violence done to the mucous tract of the cervix is seen in the black ecchymosed condition of the cervix and os in women who have died soon after labor. This appearance we have never known absent. Several museums contain characteristic specimens. The proof of the sliding down of the lower segment and cervix is seen in the œdema in the perimetric connective tissue. This traumatic process may be the starting point of perimetritis and puerperal fever.

The crushed mucous membrane, or at least the epithelial layer falling into necrosis, is almost necessarily shed during the process of repair.

After labor the os externum is flabby, soft, sometimes difficult to trace; it offers no obstacle to the introduction of one, two, or even three fingers; but commonly obstruction is met at the os internum, a structure which yields more readily under distention without tearing than does the os externum, and which is moreover surrounded by more active contractile muscular fibres.

THE LENGTH OF THE NECK AFTER LABOR.—This point has been investigated by Breisky, Florinsky, Lott, and others. Lott[1] found the mean length of the cervix from the edge of the os internum to the os externum to be 7 centimetres after labor. The cervix, therefore, is elongated. The anterior lip is longest. Where the length is much less than 7 centimetres, it is generally in multiparæ and in cases of placenta prævia. The neck gradually shortens in the succeeding days, so as to measure on the twelfth day about 3 centimetres. On the twelfth day the neck has nearly regained its ordinary length, but the body of the uterus, still twice its proper size, goes on diminishing.

Whilst lessening in length the neck increases in thickness, and its orifices contract. The os internum may, according to our own observation, have recovered its ordinary calibre at least nearly, in two months; but the os externum rarely does so. We have, however, met with exceptional cases, in which the os externum had returned to the condition of a small, round, perfectly smooth aperture, exactly resembling that which is so commonly associated with sterility, so that it would be unsafe to pronounce an affirmative either of gestation or sterility from the condition of the os externum.

The lining membrane of the cervix no longer presents the longitudinal folds nor the circular folds; the oblique folds of the arbor vitæ which had been obliterated by the distention undergone during labor become visible again.

The *broad ligaments, tubes, and round ligaments* gradually recover their ordinary characters. The serous fluid effused in the connective tissue is rapidly removed under the energetic absorption process which sets in on the third day after labor.

The hypertrophied tissue of the heart, like that of the uterus, it can hardly be doubted, is got rid of by a similar process. But precise observation is more difficult. Robert Barnes, however, has seen the heart some days after labor in the state of fatty metamorphosis. The cases, it is true, have chiefly been those of women somewhat advanced in years, and in whom it may be supposed that the change was morbid, or true fatty degeneration. This objection may be valid. Further observations are desirable.

[1] Verhalten des Cervix Uteri während des Wochenbetts, 1872.

THE CONDITIONS THAT FAVOR INVOLUTION ARE:

1. A healthy organization. The aphorism that "pregnancy is the great test of a sound body" is especially proved here. It is of prime necessity that the secreting and excreting organs be sound and in good working condition.

2. The due establishment and maintenance of lactation. We have seen reason to conclude that the breasts are ancillary, if not necessary parts of the great excretory system. Further, the diastaltic function is healthily stimulated by the due exercise of this function. The uterus is thus stimulated to contract.

Involution is more rapid in women who are delivered at term than in those delivered prematurely.

There is a divergence of opinion as to the rate of involution in primiparæ and in multiparæ. French authors generally affirm (Tarnier) that involution is more rapid in primiparæ. Schrœder and Scanzoni think the reverse. Serdukoff holds a third opinion, namely, that in young pluriparæ, having had one or two children, involution is quicker than in primiparæ and in elderly pluriparæ who have had many children.

The influence of lactation in promoting involution is contested. Depaul, Charpentier, and, quite recently, Milsom,[1] maintain that lactation retards involution, whilst Pinard maintains that lactation quickens it.

Gassner has shown that the diminution of body-weight is less in non-suckling women than in those who suckle. Hence, the conclusion seems justified that the general process of involution and absorption after labor is promoted by suckling; and the presumption is strong that the uterus is affected in like manner.

The healthy exercise of the emotional and psychical faculties, arising from the satisfaction of maternal duty, is extended from the brain to the other nervous centres which are more immediately concerned in the regulation of nutrition.

3. That the hygienic conditions and other surroundings be good. Pure air, cleanliness, and good food are essential.

THE CONDITIONS THAT IMPEDE INVOLUTION.—These are naturally the opposite of those which favor involution.

Inability to suckle may be taken as evidence of the defective health condition of the subject. Where the system or the breasts are unequal to the performance of this function, not only is one natural stimulus to involution and excretion wanting, but it may be expected that other organs are also unequal to their duty. In the other case of deliberate abandonment of this duty, similar evils will result, and it is unreasonable to expect immunity. Many of the cases of uterine disease associated with subinvolution may be traced to the neglect of lactation.

Another special cause is seen in retroversion and prolapsus of the uterus, a condition not uncommon after labor. The strangulation of the vessels supplying the uterus maintains a state of hyperæmia, a consequence of which is serous effusion into the uterine tissue. Where this displacement occurs, involution is almost surely retarded.

Metritis, perimetritis, pelvic cellulitis, any fever, all retard involution and also retard excretion, perverting or checking glandular action.

RETURN OF THE UTERUS TO ITS PRIMITIVE SITUATION.—Wieland states that, concurrently with its diminution in volume, the uterus tends during the first twelve days to resume its position in the median line, quitting the obliquity to the right or left, which it maintains during gestation. During

[1] Thèse de Lyon.

the later period of childbed, the laxity of the ligaments and the mobi of the organ permit it to sink into the pelvic cavity. But as the ligame and especially the vagina and perineal floor, recover tone, the uterus rise its normal level.

CHANGES OF CONSISTENCY.—In healthy conditions, the uterus immedia after labor feels, to use an English illustration, "as hard as a cricket-ba especially if ergot have been given. Then it relaxes at intervals, rhyth action still prevailing. During the succeeding days the uterus is softer, still contracted. On the third day and the fourth it is like elastic or fibr tissue. According to Wieland, at this time, which corresponds to the m mary flux, the uterus is softer. Further on, these alternations of hardn and softness disappear, and the uterus regains nearly the firmness it before pregnancy.

It is necessary to bear in mind that when the uterus fails to contract tissues, especially in elderly multiparæ, may be so soft that the sound or finger may, if used roughly, easily penetrate, and even perforate, the wa

CHANGES OF SHAPE.—After delivery, the uterus becomes globular little ovoid. The sides and the fundus remain more arched, and never q regain the straightness of the nulliparous uterus.

The Lochia. DEFINITION.—By this term is understood the discha which take place from the genital canal after the completion of labor, du the period of involution. This concurrence in time of the lochia with in lution and excretion associates these acts as parts of the same physiolog process. We accordingly find that when the lochia are abruptly suspen the involution process is disturbed.

From the definition of the lochia above given must be excepted (1) first or immediate discharge of blood, the "physiological hemorrhage;" secondary or recurrent hemorrhages; and (3) certain vitiated discharges

When the uterus contracts in casting and expelling the placenta, superfluous blood in the arteries and sinuses is squeezed out; part is driv back into the general circulation, part is shed on the free internal surface the uterus. The blood so shed is the "physiological hemorrhage." To th primary bleeding succeed "the lochia." During the first few hours the d charge is *sanguinolent*, then it becomes *serosanguinolent*, and this charact is maintained for a variable time, extending to eight or ten days. These a called "the red discharges" or the "red waters." They are composed of serosanguinolent liquid, and usually contain minute, sometimes large, clo Commonly, after six days, the lochia are no longer red; the discharge th is chiefly serous of a yellowish turbid green, the "green waters." Then th become whiter, *purulent* or *puriform*. This character continues for ten fifteen days; in some women this discharge continues until menstruation reëstablished. But in this case it may properly be said to have merged in leucorrhœa, and indicates imperfect involution or endocatarrh.

The *quantity of the lochial discharge* is variable within physiological limi Gassner estimated that the discharge during the first three days amount to 2 lbs., the loss during the fourth and fifth days 280 grammes, from t sixth to the eighth day 205 grammes. So that during the week followi labor the puerpera would lose by lochial discharges about 3 lbs. In pra tice, a rough estimate is made by counting the number of napkins used.

The lochia do not always present uniformity in order, in appearance, a quantity. For example, when the milk secretion is forming, the lochia a sometimes diminished or suppressed, and resume their ordinary course wh the milk secretion is fairly established.

Accidental disturbances of the nervous system disturb the even course the lochia. Emotions notoriously do this, sometimes checking the flow, b

more commonly exciting hemorrhage. Very sensitive women often lose blood whenever, in the early days of lactation, the child is put to the breast. It seems as if emotion, or pain, or reflex irritation suspended the inhibitory functions of the nerves which govern the circulation.

It has been said that the lochia are more abundant in women who do no suckle, and more abundant in pluriparæ than in primiparæ.

It has been said that in some women the lochia have been altogether wanting. This requires proof. Caseaux, however, relates an instance. On the other hand, Robert Barnes has described[1] the persistence of an immoderate flow of nearly limpid fluid for some weeks after labor—a form of hydrorrhœa. This, he conjectured, came chiefly from the glands of the neck of the uterus, like one form of the *hydrorrhœa gravidarum*.

The lochia give out a peculiar odor. To this is commonly attributed the "*gravis odor puerperii*." But we believe the odor is also exhaled in some women by the skin and by the lungs. The odor thus exhaled may be taken as evidence of the absorption of lochial discharge into the system. In such cases we have noted a sallow aspect and a degree of febrility. We have taken this as an indication for syringing the uterine cavity with a weak tepid solution of carbolic acid or bichloride of mercury.

The following description of the microscopical and chemical character of the lochia is condensed from Tarnier and Chantreuil.

Microscopical Characters of the Lochia.—Ch. Robin has shown that the blood which flows from the uterus after labor in most women contains leucocytes in the proportion of 1 to 5 in 100. A similar proportion is observed in the lochia during the first day. But it is not possible to determine whether these white globules come solely from the blood, or if, as is probable, a certain number are already produced on the inner surface of the uterus. After the first day, the lochia contain only about one-third of red globules, and two-thirds of other elements in suspension in the sero-mucous fluid. These other elements are white globules or leucocytes in slightly less quantity only than the red globules; they are isolated or agglutinated together, forming masses of variable size. There are also epithelial cells from the neck of the uterus of the pavement type or calciform, according to the region from which they came. Wertheimer[2] found corpuscles of the embryonic connective tissue or in course of formation. These elements are simply the *débris* of the caduca which had remained adherent at the casting of the placenta. He also found crystals of cholesterine.

The viscid liquid which holds these elements in suspension is studded with numerous grayish molecular granulations and a certain number of small fatty granules.

From the second day, whilst the red globules diminish, the leucocytes increase in number. Soon they outnumber the red globules, and the lochia become gradually reddish or reddish-gray, and then grayish, or yellowish-white, or greenish. After the fifth, red globules are very scanty. The leucocytes become the predominant element; some have become voluminous, full of granules, and form what are called "granular globules." Along with these elements are found pavement-cells of the vaginal epithelium, often imbricated, in lamellæ, to which the other elements are adhering. Some polyhedric, or nearly spheroidal cells, similar to those of the deep layers of the vaginal epithelium or of the neck of the uterus, are also found.

Towards the end of the lochial flow the leucocytes, which had undergone fatty change, and the fatty granules, have diminished in quantity. The

[1] Gynæcological Transactions, American, vol. i., 1876.
[2] Archiv für Pathol. Anat. u. Physiol., etc., Bd. 21.

lochia may still contain from the beginning *protozoa*, as the *Trichomonas vaginalis* of Donné, and the common bacteria observed by Haussmann and Hugh Miller.

According to Doléris, whose observations were made in the laboratory of Pasteur, there are almost always found in the purulent lochia the *double micrococcus*. This may be met with in healthy women; but in them it is rare. It is only when it multiplies that it becomes dangerous. On the other hand, it is only in sick women that the *micrococcus en chapelet* is found. This is the microbe which Pasteur is disposed to regard as the microbe of puerperal fever. All these microbes pullulate in alkaline media; acid solutions, and especially phenic solutions of 1 in 50, kill them. Eustache (1884) found the microörganisms under normal as well as pathological states.

Chemical Composition of the Lochia.—During the first days after labor, the reaction is alkaline; after the eighth day it becomes neutral or acid. At the beginning albumen is found; later, mucin, saponified fat, chlorides, alkaline phosphates, or phosphates of lime and iron, are found.

Modifications of the Principal Functions during Puerpery.

If the labor have been easy and not protracted, the woman experiences a sense of ease; the skin is fresh, there is no rise of temperature; the pulse is normal or even slowed. After difficult and prolonged labor, exhaustion is more or less marked. The face is suffused, the eyes sometimes injected, the skin hot, the pulse frequent; sometimes the patient sinks into deep sleep, others remain excited and restless. Some women experience a rigor or shivering immediately after the delivery of the child or placenta. This phenomenon is entirely reflex, and indicates nothing of serious import. Stoïcesco[1] has studied this subject by thermosphygmic tracings taken at the moment of the shivering, and affirms that it is never attended by rise of temperature or of pulse. This completely differentiates it from the rigors of pathological significance.

Three things call for specially careful observation during puerpery: the pulse, the respiration, and the temperature. As a general rule the pulse and temperature rise or fall together, and when both rise the respiration is almost invariably affected as well. The respirations increase in frequency and become shorter. So long as we note normal conditions and relations of these phenomena we may feel confident that the puerperal process is pursuing the desired physiological course; and when, on the other hand, we detect any marked or continued departure from these normal conditions and relations, we must be prepared for pathological complications.

The Pulse.—In adult women the pulse usually beats 75 to 80 times in the minute; that is, it rises a little during gestation and labor. Immediately after labor the pulse often falls to 60 or 55, sometimes to less; but generally this slowing is soon followed by quickening, which lasts several hours. After this transient quickening the pulse often slows again. This slowing was first described by Blot.[2] The extreme limit observed by Blot was 35. We ourselves, in a perfectly healthy woman, whose pulse before labor was 75, recorded 40 on the second day. Two figures struck Blot as specially common, namely, 44 and 56. This slowing may last from one to twelve days. Generally it lasts longer in pluriparæ than in primiparæ. There are individual differences in the time of its setting in. Most frequently it sets in twenty-four hours after labor. During the succeeding twenty-four hours it is more

[1] Thèse Inaugurale, Paris, 1876, and Tarnier.
[2] Archives Générales de Médecine.

marked, and then gradually it disappears, and is followed by the ordinary pulse.

Sometimes the slowing ceases entirely when the breasts undergo the hyperæmia which precedes the secretion of milk; but more commonly the slowing is a little diminished.

The slowing of the pulse is observed after abortion and after premature labor, spontaneously or artificially induced.

When this slowing of the pulse is observed in a recently delivered women, we may be assured that she is in a perfectly healthy condition. It is, therefore, a sign that justifies a favorable prognosis. Tarnier says, in a lying-in hospital the prevalence of slow pulses may be taken to indicate good sanitary conditions; the contrary condition indicates some noxious influences that challenge prompt and searching inquiry. The accuracy of these conclusions is amply proved by the experience of Fancourt Barnes in two lying-in hospitals.

What is the Cause of the Pulse Slowing?—The sphygmographic observations of Blot and Marey establish that this slowing stands in relation to a certain degree of increase of arterial tension, and these authors believe that this tension is explained by the almost sudden arrest of the circulation which had been going on in the uterus during gestation. The blood then, which hitherto had traversed the uterus, is turned into the arterial system of the greater circulation, whence results a greater tension, causing obstruction to the ventricular systole, and slowing of the pulse. Later on the equilibrium is restored. This theory is supported by the fact that when hemorrhage occurs the tension is lessened, and the pulse is accelerated. We should attribute greater influence to the hypertrophy of the heart which attends gestation.

Many observers have reëxamined and criticised the statements of Blot. Generally they have been confirmed. Close observation, during many years, convinces us of their accuracy.

Hémey[1] further showed that in a certain number of women recently delivered the pulse was subject to irregularity in force and frequency. These alterations in rhythm attended the slowing of the pulse. They commonly disappear in a few days. Since the publication of Hémey's thesis, Robert Barnes has studied this question, and is able to confirm Hémey's statements. He examined the heart without finding anything abnormal in this organ.

The slowing and irregularity of the pulse after labor should be carefully studied in association with the course of the involution process.

Modifications of the Blood after Labor.

We have seen that during pregnancy the fibrin, water, and white globules are increased in proportion, whilst the red globules are diminished. These conditions are continued in increased degree after labor. Andral and Gavarret, Becquerel and Rodier, and, more recently, Laurent established these facts. The researches of Malassez, of Bouchat and Dubrisay, of Fouassier, have proved in the clearest manner the increase of white globules; and Peter has called this increase *physiological leucocytosis*. It attains its maximum about twelve hours after labor.

Further investigations, chemical and microscopical, into the constitution of the blood in pregnancy and childbed are greatly to be desired; they could hardly fail to throw useful light upon many interesting problems in physiology and pathology.

[1] Archives Générales de Médecine.

Cardiac Murmurs in the Puerperal State.

Dr. Money has made interesting observations in the General Ly Hospital.[1] He concludes that systolic murmurs occur in 75 per cen the præcordia of lying-in women. These murmurs are of three sort The "Endocardial-like" murmur is conducted to a variable extent; n heard over any part of the area of the præcordia; (2) is "friction and non-conducted, of very constant site, just above and to left of x cartilage; (3) is very loud, of curious quality, very capricious, and no ducted. The most numerous of the first sort are loudest over the ventricle, close to the edge of the sternum. They are not the expres serious mischief; they are "functional murmurs."

We believe them to be simply hæmic, due to altered character of the and the state of the heart, which must change as the uterus does in ti

Modifications of Respiration.

Inseparably linked with the condition of the blood and circulati the movements of respiration. Healthy women after labor breathe 18 times a minute, rather less frequently than during gestation. spent great pains in investigating the relative capacities of the chest i pregnant, pregnant, and puerperal women. In 60 per cent. of r delivered women he found an increased capacity; in 24 per cent. a diminution, and in 16 no alteration. These results have been met b observers who affirm that the pulmonary capacity is lessened after Systematic observations with the spirometer are needed.

Variations of Temperature in Childbed.

Under healthy conditions, individual and sanitary, no important temperature is observed. Observations made in lying-in hospitals show a rise of over 0.5° Fahr. cannot be accepted as normal. A slig has been noticed twelve or twenty-four hours after labor. This is so lowed by return to the standard.

Slight oscillations may be accounted for by the natural rise towa evening, by passing emotions, or irregularities of diet. Transient var need occasion no anxiety, but it is far different when the rise is cont and lasting.

Modifications of the Urinary Secretion.

To estimate these we must refer to the chapter on pregnancy (vol. a statement of the character of the urine in that state. Lehmann that the urine of very young children and pregnant women often co very little phosphate of lime. The urine of women not pregnant co more water, less salts, and less urea than that of men. These diffe are especially marked in pregnancy. In the later months there is of little phosphate of lime that it is difficult to detect the presence of lim

Winckel,[2] Kleinwächter,[3] Quinquand,[4] and others have studied the acter of the urine in childbed. They generally agree. The quanti

[1] Med.-Chir. Trans., 1882.
[2] Studien über den Stoffwechsel bei der Geburt und Wochenbett, 1865.
[3] "Das Verhalten des Harnes," etc., Arch. f. Gynäkol., 1876.
[4] Essai sur le puerpérisme infectieux, Thèse, 1872.

urine is especially increased during the twenty-four hours after labor. The quantity may rise to 2360 grammes; the mean is 1600 grammes. In some women this transient polyuria appears on the second or third day. Winckel states the mean weight of the urine expelled during the first eight days by a healthy woman is on an average 12 lbs., or 1175 grammes daily. The kidneys, therefore, eliminate a large quantity of water.

The specific gravity is generally diminished on the first and second day, varying from 1010 to 1018. When fever occurs, it may rise to 1020 to 1022. After the third day, the density increases to 1022 or more, even in cases where there is no fever. In the nursing woman, Quinquand says it may rise to 1025. Recently delivered women who are free from fever during labor excrete less urea than in pregnancy. Quinquand says, "the quantity of urea eliminated in twenty-four hours, during pregnancy, exceeds the physiological mean, and varies from 30 to 38 grammes; whilst in the twenty-four hours following labor it falls to 20 or 22 grammes."

The second day after labor the urea increases, but rarely exceeds the normal quantity, unless fever intervene. On the third day, if there is no fever, the urea may exceed 30 grammes.

From the fourth day, if there is no fever, if there is milk and the child sucks well, the urea diminishes sensibly, and may fall to 19 grammes in the twenty-four hours. In suckling women, the average excretion of urea daily is 20 to 22 grammes.

The chlorides behave like the urea—that is, they diminish the first day, increase the second and third day, and diminish again when the milk has set in.

According to Winckel, during the forty-eight hours following labor there is a diminution of sulphates and phosphates.

The products of oxidation of the organism, of urea especially, would be in a larger proportion in the urine if they were not also eliminated by the lochia, sweat, and milk. The functions of the skin are more active some hours after labor, and continue very marked for five or six days.

The different secretions—cutaneous, renal, lochial, mammary—appear to supplement each other. The exaggeration of one may entail the diminution of the others: thus, when the milk is abundant the lochial flow is generally less.

The increase of the excretions, the extraordinary elimination of the products of oxidation, the regressive metamorphosis of the uterus and other tissues, must entail a loss of weight in the puerpera. Gassner and Hecker established that during the first eight days women lose on an average 4571 grammes—that is, about one-twelfth of their body-weight.

Glycosuria.—Blot's statement that sugar is frequent in the urine of newly delivered women has been sufficiently confirmed. De Sinéty,[1] who had studied the question with especial care, showed that glycosuria can be produced at pleasure in suckling women by abruptly suppressing the milk. Sugar likewise appears in the urine whenever there is any obstacle to the secretion or flow of milk. When the production and yield of milk are evenly balanced the sugar disappears from the urine. Towards the second or third day the milk secretion is abundant, and the child consumes but little; sugar is found in the urine. Tarnier and De Sinéty started the theory that the sugar eliminated by the kidneys was sugar probably made by the liver with a view to the lacteal secretion, and which could not be utilized in consequence of the temporary suppression of this function. But if this were so, why, of all the immediate constituents which enter into the composition

[1] Recherches sur l'urine pendant la lactation, 1873.

of milk, is the sugar alone eliminated by the urine? To this Gubler answered that the passage of sugar—a crystalloid and dialyzable body—is much more easy than that of albumen—a colloid body, which does not traverse the dialyzers; that albuminuria always supposes a renal hyperæmia which borders on inflammation, whilst glycosuria is effected without any anatomical modifications of the kidneys.

De Sinéty observes also that the microscope reveals the presence, in all the saccharine urines of suckling women, of numerous fatty granulations insoluble in acetic acid, and colored dark brown by osmic acid.

The Changes in the Breast: the Secretion of Milk.

A fundamental anatomico-physiological fact must be borne in mind. The breasts are really skin-glands; they form a part, specially developed, of the great glandular system of the skin. The secretion of the breasts assumes, indeed, a particular form, and is destined for a particular purpose, the nutrition of the infant. But the breasts do not on that account cease to take part in the great process of elimination which is carried out by the glandular system of the body. There is a physiological relation between the secretion of milk and the conversion of the tissue, which had been created for the purposes of gestation and parturition, into fat.

Women nursed in the lap of luxury, whose emotional and intellectual faculties have been indulged and cultivated at the expense of their muscular system, rarely acquire a healthy glandular development. The skin, become a thing of beauty, fails as an organ of health. Under the trial of puerpery and lactation it breaks down. The breasts cannot perform their duty, and more work is thrown upon other organs which also are likely to be inefficient. Hence it is that we so constantly find in women of the easier classes that lactation cannot be performed. Honest attempts are sometimes made; but after suckling with difficulty for a few days, during which time the infant suffers and pines, the milk is found to fall off; the breasts dry up, or become inflamed, and the cherished hope is abandoned.

Period of Formation of Milk.—In some women a little milk may be squeezed out of the breasts during pregnancy; in others it oozes out spontaneously, soiling the linen; and in this manner the suspicion of pregnancy has been excited. But in most women no secretion of moment shows itself until after labor. The usual time of its appearance is the third day, rarely earlier; sometimes it is delayed until the fourth or fifth day, and in some it can hardly be said to appear at all.

The capacity for secreting milk furnishes another illustration of the aphorism that "Pregnancy is the test of bodily soundness." The woman may have carried her child with more or less comfort through gestation and labor, but at this point she may fail. This is especially the case with the daughters of Dives. The formation of milk is attended by certain *local phenomena*. The breasts immediately after labor are commonly flaccid or soft, and of the size they had attained during gestation. But in two or three days the breasts increase in volume, become firmer, even hard. The integument is stretched, smooth, shining, streaked with bluish veins which sometimes unite with those of the opposite breast. The nipple becomes less prominent, sometimes rendering suckling difficult.

Tarnier draws attention to the occasional appearance of subcutaneous œdema in the region of the areola. It is more frequent in primiparæ; it is frequent in domestic animals.

THE CHANGES IN THE PROPER STRUCTURES OF THE BREASTS ATTENDING THE FORMATION OF MILK.—The following account is drawn from Virchow, Kölliker, and Robin.[1] Virchow,[2] starting from the homology between the breast and sebaceous glands, says that both are produced by a progressive proliferation from the internal layers of the epidermis. To the same category belong the ceruminous glands of the ear, and the large glands of the axilla. In all these cases the fat which constitutes the chief constituent of milk, at least as far as its external appearance is concerned, and which furnishes the sebaceous secretion, originates in the interior of epithelial cells which gradually perish and set the fat free, whilst scarcely a trace of the cells is preserved. The sebaceous glands are generally seated on the sides of the hair-follicles at some depth below the surface; we there find a series of minute globules into which a prolongation of the rete mucosum is uninterruptedly continued. The cells of this become more numerous and larger, so as to fill the gland-sacs with a nearly solid matter. Then the fat begins to be secreted into their interior, at first in small particles, which soon become larger; and after a short time the individual cells can no longer be distinctly perceived, but only conglomerations of large drops, which rise up out of the gland into the hair-follicle. The secretion is a purely epithelial one, like the seminal secretion. This process furnishes us at the same time with an account of the *formation of milk*. One need only imagine the ducts much lengthened, and the terminal acini greatly developed; the process is essentially the same; the cells multiply abundantly; the multiplied cells undergo fatty metamorphosis, and ultimately there remain scarcely any material traces of these cells excepting the droplets of fat. The closest resemblance to the manner in which the secretion of sebaceous matter ordinarily takes place is presented by the earliest period of lactation, when the so-called *colostrum* is yielded. (The colostrum was discovered by Donné.) *A colostrum-corpuscle is the still-coherent globule which results from the fatty metamorphosis of an epithelial cell.* The formation of colostrum and sebaceous matter differs in this respect only, that the fatty granules remain smaller in the former case, and that whilst large drops very soon show themselves in sebaceous matter, in colostrum the last cells which are observed usually contain only minute fat granules, very densely aggregated, whereby the whole cell acquires a somewhat brownish appearance, although the fat has no natural color. This is the granular corpuscle, "*corps granuleux*," of Donné. For the discovery of this gradual transformation of cellular bodies into fat granules we are indebted to Reinhardt. Still, we shrank from extending this important discovery of the formation of colostrum to the history of milk in general, for the reason that during the later periods of lactation granulated bodies are no longer met with. But the only difference is that the colostrum process goes on more stoutly, and that the cells maintain their cohesion longer, whilst the milk process is acute, and the cells more speedily perish. Perfectly developed colostrum contains an extremely large number of granulated corpuscles, with nothing more than a number of comparatively large and small drops of fat mixed up together, the so-called milk corpuscles, which are nothing more than drops of fat, and, like the majority of the drops of fat that occur in the body, are surrounded by a delicate albuminous membrane called by Ascherson the *haptogenic membrane—i. e.*, produced by contact. But the individual drops, milk-corpuscles, correspond to the drops which we find in the sebaceous matter. They are produced by the coalescence of the minute granules which appear in the secretion of colostrum.

[1] The student should turn back to the section in which is described the Anatomy of the Breast (vol. i).

[2] Cellular-Pathologie.

This haptogenic membrane was admitted by Henle, Dumas, Robin, Frey, and Kölliker, but it seems to have been definitely proved by De Sinéty[1] that its existence is due to accident. Thus, when the milk is examined immediately after being drawn, and the use of coagulating reaction is avoided, this envelope is not found.

The colostrum corpuscles characterize the first milk. After a few days they generally disappear, and nothing is seen under the microscope but highly refracting oil or fat droplets of various sizes. Kölliker cites Donné as stating that in inflammations and swellings of the mammæ during lactation the milk assumes the nature of colostrum. This is contradicted by d'Outrepont and Münz.[2] During menstruation, Donné and d'Outrepont found colostrum-corpuscles in the milk. This fact Robert Barnes has verified; he found colostrum-corpuscles reproduced at every menstrual period, lasting for seven days or more, and then disappearing in the intervals. Lehmann states that they occur in the course of any acute affection which may supervene during lactation. Donné regarded them as proof of bad milk. In the foot-rut of animals Herberger and Donné found the milk to possess more of the characters of colostrum. In milk which has become sour, the caseine is found coagulated in the form of granules, and the milk-globules gradually coalesce into larger drops. Blue and yellow milk contains, according to Fuchs,[3] infusoria, themselves without color, which he called *Vibrio cyanogenus* and *xanthogenus*. These, when mingled with healthy milk, will impart a color also. This is confirmed by Lehmann for blue milk. According to Baillent[4] and Lehmann a fungus also exists in such milk. C. Nägele has observed red milk, and found a vegetable formation of the nature of a protococcus in it. But pinkish milk may be suspected to contain, and Hassall figures, blood globules in such milk.

Milk consists of a fluid portion or plasma holding in suspension innumerable round, dark, shining corpuscles varying in size. These are the milk-globules; it is to these corpuscles that the milk owes its white color. In fresh milk these corpuscles are animated by Brownian movements.

Breast Abnormalities.—1. *In defect.* In some women the breasts are so little developed that they are unfit for the secretion of milk.

2. *In excess.* Supernumerary breasts and nipples.

Reflecting on the histological identity of the sebaceous and mammary glands, we can readily understand the occasional development of the breasts in men and the formation of milk in them. Not to mention other examples, there is the famous one recorded in John Hunter's Notes and Essays (edited by Owen). A man, aged 50, had married a women who fourteen years before brought forth twins, male and female. To soothe the male child, the father used to apply his left nipple to the infant's mouth; the child drew milk and throve upon it. This man treated eight succeeding children in the same way, sharing the duty of suckling with his wife. But what is very remarkable is, that he had a constant flow of milk for long after he had ceased to suckle. The lymphatics, bloodvessels, and conglomerate glands of his breasts presented the same appearance as in women. He stated that when he suckled the first child all his natural secretions were diminished, especially the sweat, which he was much subject to before; and that he had not the slightest appetite for venery for several months after.

The Duration of Milk Secretion—The usual duration of the capacity for suckling may be stated at nine months. But in many women, chiefly of the laboring class, suckling is protracted to twelve months or even

[1] Archives de Physiologie de Brown-Séquard, Charcot, et Velpeau.
[2] Neue Zeitshrift fur Geburtskunde. [3] Comptes Rendus, xviii.
[4] See Scherer, art. "Milch" in Handbuch des Physiologie.

longer, and we have known instances of women, who having lost their husbands, have concentrated their womanly instincts upon the child at the breast, and continued this duty for over two years. We have even seen a child get up on a stool and stand whilst suckling. In such cases the breasts retain their dominion over the ovaries; menstruation may be performed, but this function is often disturbed or suspended.

A condition analogous to the above is seen in women who give themselves up to the duty of wet-nursing. These sometimes will persist in nursing for eighteen months or more. We have known an example of a Spanish wet-nurse who nursed three successive children in one family, and we are informed that it is the custom in some parts of Spain to engage a wet-nurse who, having suckled the first child, will take up in succession all the children her mistress may bring forth, herself living all the while in celibacy.

We also know a lady, richly endowed physically, intellectually, and artistically, who living with her husband, and menstruating regularly, has nevertheless gone on secreting milk five years after the birth of her only child, which she suckled only for a short time.

What to Observe in the Puerpera and her Child.

Take the catheter, thermometer, and stethoscope as companions.

Objective Observations.—1. Count the pulse, note its rhythm and strength (sphygmographic observations also may be useful).

2. Count the respirations, note their depth.

3. Note the temperature in mouth or axilla, and exceptionally in vagina.

4. Note aspect, manner, and speech, and the tongue.

5. Apply hand to abdomen, to note flaccidity or tension, pain. If tension and pain, note shape of abdomen, and define area of dulness or resonance. If dulness extend to umbilicus or nearly, pass the catheter.

6. The state of the genital organs. It is desirable at some time to examine by touch to ascertain if the uterus is in normal position. The perineum, as to integrity. The discharges. Watch the involution of the uterus by its retreat towards the pelvis.

7. The breasts. State of nipples, as to form, size, integrity. State of breasts, as to size, uniformity of consistence, tenderness, secretion of milk. The quantity and quality of the milk, ease of yielding, microscopical characters.

The Observations to be made by the Attendant on the Day after Labor, and from Day to Day.—Interrogate all the functions. The aspect of the patient, her manner, her voice, and mode of answering questions tell nearly enough the state of her brain. Has she pain? Generally there is a sense of muscular soreness and fatigue. Feeling the abdomen, we ascertain if there is tenderness on gentle pressure, and if the abdomen is tense or flaccid. If there is tenderness or prominence, or both, this may be due to intestinal distention, to fulness of the bladder. The real condition of the bladder must be determined. Inquire into the state of the bowels. The rectum was probably unloaded during the labor, and for two or three days after it is usually sluggish. If there is diarrhœa we must look to the associated symptoms. Ask the patient if she can freely move her limbs. There should be no difficulty in this except in the sense of soreness. Note three points especially, and record them—pulse, temperature, and respiration. The pulse should be 70 or 80, if even lower but steady it is good; the temperature should be 99° Fahr., the respirations 18, or not exceeding 20, in the minute, easy, the chest expanding.

Inquire as to the *lochia*, see the napkins. Feel the *breasts*. On the second and third days there may be no sensible difference in their condition, but at the end of the third, and more generally on the fourth, the breasts are usually fuller, firmer, somewhat tender, and milk may ooze from the nipples.

Subjective Information, and from Nurse or Attendants.

1. As to nutritive functions, appetite, digestion (vomiting? colic?), defecation, micturition. Are the stools or urine passed naturally?
2. Respiration: distress in breathing? Circulation: palpitation?
3. Innervation: sleep; sense of ease, lassitude, or depression; headache or not; the condition of the taste, smell, hearing, sight, sensation; have speech and manner been natural? test the power of moving the limbs. As to rigors. As to abdominal pain (inflammatory or colic); as to uterine pain (after-pains); as to pains in limbs and joints.
4. The skin: heat, moisture, perspiration, odor from.
5. The excretions: by lungs, by skin, by bowels, by bladder, by vagina. The lochia especially as to quantity, color, odor. Is there any shred, membrane, or unusual complication? One rule is important. Do not suffer the nurse to answer questions you address to the patient.

The *favorable signs* are: pulse not exceeding 90; temperature 99° Fahr.; soft, painless abdomen, bladder acting naturally; spirits cheerful.

All these observations will be made with the least possible disturbance of the patient. Some will be made almost without her consciousness or attracting attention of attendants; some may be pretermitted on occasion. They should be made in a certain order, so as to insure that nothing important is omitted, and to avoid fatiguing the patient by repetition. These observations methodically taken will serve to recall the chief points in the preceding history of the puerpera. By turning back to the description the reader or practitioner may refresh his mind as to the significance of the points noted for observation. He will appreciate any departure from the standard conditions; if any new interposing condition is observed we may draw information of diagnostic, prognostic, and therapeutic value. And, lastly—a point not to be disregarded—we add to our own value as scientific clinical physicians by a course of study rich in physiological and pathological illustrations.

The Care of the Woman Recently Delivered and her Child.

1. The hands which have helped to squeeze out the placenta, or simply to second the expulsive contractions of the uterus, will give information as to the condition of the organ. If it be well contracted, the woman may take a little rest to allow her to recruit her nerve-force, always watching to ascertain if the uterus relax. In pluriparæ, thirty minims of ergot may now be given to promote contraction. But it must be specially borne in mind that it is bad practice to give ergot before the uterus is empty both of placenta and clots. Ergot is very apt to induce spasmodic contractions of the lower segments of the uterus, and thus to imprison whatever may be in its cavity.
2. If there be spasmodic or colic pains after the extrusion of the placenta, the first thing to do is to make sure that the bladder is empty. Use the catheter. This done, tight compression of the uterus by the hand, to provoke contraction, may be used.
3. Cleansing the genital parts. If sponges be used, they should have been soaked in a solution of 1 in 50 of carbolic acid, and fluid of the same kind should be used. The fluid should be squeezed out of the sponge so as to run

in streams over the part, rather than to wipe or rub. The labia majora and minora may be held gently apart to let any clots escape from the vagina. Wadding should be used instead of sponges, and be burnt after use.

If there be retention of blood or clots in the vagina, gentle syringing with the carbolic solution may be practised.

4. This is the time to ascertain if there is any lesion of the perineum or vulva. If there be only slight rent, no operation is necessary; if a rent extend to near the sphincter, and, *à fortiori*, if it involve the sphincter, the wound should be united by silver wire sutures. Three or four will commonly be required. The first should be passed deeply close to the anal extremity of the split, the others less deeply as we approach the anterior edge of the perineum.

5. The dressing of the vulva usually consists of folded diapers. We strongly advise that this practice should be discarded. We can rarely feel sure that "things coming from the wash" are pure. It is best to use pads prepared with carbolic acid or other trustworthy antiseptic, or the carbolized gauze used in surgery. These should be renewed as often as soaked and burnt. We thus not only avoid one source of danger to the patient in charge, but avoid the risk of propagating the infection to other persons.

6. *The binder.* A revolt was raised some time ago against the traditional practice of binding the abdomen after delivery. It did not succeed. The objections to the binder are unsound, whilst the uses of it are clear and decided. In pluriparæ, especially, the abdominal walls are extremely flaccid. The sudden expulsion of one-tenth of the body-weight from the abdominal cavity is attended by a sudden removal of a force hitherto pressing upon the vessels and organs of the chest, abdomen, and pelvis. This entails in some cases a tendency to vacuum. Hence disturbance of the circulation. Now, the binder, by supporting the abdominal walls, restores the equilibrium of pressure. The pressure exerted upon the uterus works as a gentle continuous stimulus to contraction. The woman is conscious of the support and is grateful for it.

The abdominal walls, thus supported, now quickly regain tonicity, and return far more nearly to their pristine strength and flatness. The figure, so precious, and rightly so, to women, is better preserved.

The application of the binder. If a marked void is left in the hypogastrium, it is well to fill this up with a pad composed of cotton-wool carbolized, wrapped in prepared gauze. A broad stout towel will answer for a binder, but a bandage cut to the shape is better, as admitting of more accurate adaptation and keeping its place better. The patient lies on her back, the legs extended. Thus the lower margin of the binder seizes the hips well; the pressure obtained is more uniform, and the binder is less likely to slip up. So applied, *the binder becomes one of the most efficient agents in antiseptic midwifery;* it keeps the walls of the uterus and vagina in contact, thus preventing the collection of fluids or clots, and shutting out air.

Before leaving a patient, the genitals should be finally examined to see if there is any discharge.

The first care given, consecutive care arises. The woman should, if possible, be visited again within five or six hours after labor.

CHAPTER XVII.

THE NEW-BORN INFANT.

CHANGES ON TRANSITION FROM INTRAUTERINE TO EXTRAUTERINE LIFE—ASPHYXIA.

DURING intrauterine life all the processes connected with hæmatosis and nutrition in the fœtus are carried on through the medium of the placenta. It is usual to regard the placenta as the equivalent of the lung in the air-breathing animal. This Robert Barnes long ago showed[1] to be a very inadequate estimate of this organ. The placenta really performs not only the duty of the lung, but, in great measure at least, that of the skin, intestines, liver, and kidneys—organs which cannot be said to enter into full functions until respiration is established—another proof of the solidarity of these organs. The substitution of the lung for the placenta is the signal of a great and sudden revolution. The new functional *régime* is attended by a physical change in the organs. The fundamental changes are those that take place in the circulation. The changes in the other organs are secondary.

To take the changes in something like a natural order, we may enumerate the organs of circulation, the composition of the blood, the pulse, respiration, calorification, digestion, renal secretion, the skin, lacteal secretion, and the general growth of the new-born infant.

A brief recapitulation of the principal features of the fœtal circulation will be useful. The blood, which has been hæmatosed in the placenta, comes back to the fœtus by the umbilical vein, and soon divides into two currents; one proceeds by the ductus venosus, and is rapidly carried by the vena cava inferior into the right auricle; the other, accessory, traverses the liver, following the ramifications of the vena portæ and the hepatic veins, to terminate in the right auricle. Besides this, the inferior vena cava brings into this auricle the blood from the head and upper extremities. Into the left auricle there is poured a small quantity of blood, coming from the lungs. When the heart contracts, a part of the blood of the right auricle—or, more strictly, the blood coming from the vena cava inferior—is projected into the left auricle through the foramen of Botal. A small part only of the blood which comes to the right auricle reaches the corresponding ventricle. Of what it receives the smaller part only traverses the whole length of the pulmonary artery; the greater part is sent to the aorta through the ductus arteriosus. The left ventricle receives all the blood coming to the left auricle, whether by the foramen of Botal or by the pulmonary veins, and projects it into the aorta, where it is soon mixed with that coming from the ductus arteriosus. From the aorta the blood is distributed into the arteries which supply the head, arms, trunks, legs, and, lastly, into those arteries which return it to the placenta—the umbilical arteries.

The transformation of this provisional circulation into the definite circulation is effected by the obliteration of the umbilical vessels, of the ductus venosus, of the foramen of Botal, and of the ductus arteriosus.

We must take these phenomena in order.

OBLITERATION OF THE UMBILICAL VESSELS AND FALL OF THE CORD.—When the blood-current is turned off from the placenta, the vessels of the

[1] Medico-Chirurg. Rev., Articles, "Placenta," 1854.

cord are obliterated. The arteries retract and become impervious; a clot is formed in the vein. During the following days, the bit of cord remaining attached to the umbilicus shrinks, dries, and at last is changed into flat, horny, transparent membrane, through which are seen black lines, the remains of the umbilical vessels. The dried cord is now a foreign body as regards the living tissues of the umbilicus. At this point the skin reddens, and presently there is formed between it and the cord a circular groove filled with limpid, sero-purulent liquid. This groove deepens, and the cord is lost in about five days. The little wound resulting becomes covered with granulations, and usually cicatrizes in eight to ten days.

The sore left by the fall of the cord is open to attack by dirt, by bacteria, and is a route for absorption of septic stuff. Hence erysipelas and other diseases. The fall of the cord may be delayed when it is unusually thick, or when, as Tarnier observed, it is dressed with carbolic acid. When the child is ill the cord, instead of drying up, remains moist, putrefies, and gives rise to a foul odor.

Richet submits that the cord dies because it is strangled at its root by a circular band of muscular fibres, forming an umbilical sphincter. Parrot, however, maintains that the cord dies because it has no nutritive vessels, so that, when no longer nourished by the liquor amnii and by the blood running in the umbilical vein and arteries, it perishes. This is the general opinion. The cord falls like an eschar.

Obliteration of the Umbilical Vessels Inside the Abdomen.—This process has been studied by Robin. It begins before the fall of the cord. It is very advanced at the end of the third week, and is complete at the end of the first year. The retraction of the vessels is attended by their adhesion to surrounding tissues. The two internal tunics of the arteries, retracting towards the pubes, at last occupy the sides of the bladder; the vein, contracting towards the liver, forms the falciform ligament. The retraction begins from four to eight days earlier in the arteries than in the vein. The internal tunics become atrophied; the external tunics become hypertrophied throughout their length. Lastly, the walls of the vessels form adhesions on their inner surface. Thus the obliteration of the vessels within the abdomen is effected. The vessels are thus transformed into three fibrous filaments adhering to the umbilical ring. The bundle of arterial ligaments inserted in the cutaneous scar pulls this down, so that at the lower half of the umbilicus there is produced a crescentic depression, the concavity of which looks upwards.

Obliteration of the Venous Duct.—This, which is only a division of the umbilical vein, like it is obliterated and transformed into a fibrocellular cord after birth.

Obliteration of the Foramen Ovale.—The opening in the auricular septum persists throughout fœtal life. It closes after birth, but the conditions merit further study. The septum presents a crescentic fold, with the concavity posteriorly. At the same time, and advancing to meet it, there is developed a membranous fold, a valvule, which is destined to aid in the closure of the foramen. This fold proceeds from the left side of the mouth of the vena cava inferior; it grows from behind forwards; its anterior edge is crescentic, like the posterior border of the interauricular septum. The two extremities of the crescent of the valvule of the foramen ovale terminate in columns, one upper, one lower, which are inserted on the anterior wall of the auricle. The foramen thus bounded is gradually narrowed as the valvule grows. It has usually closed in fifteen days. From this moment the valve, growing, covers the anterior edge of the foramen, and doubles the septum. Some months after birth the valve has acquired a thickness nearly

equal to that of the interauricular septum. It is rare to find that part of the anterior edge of the valve which is included between the two columns adhering completely to the wall of the left auricle, to which this border is applied. Generally a probe can be passed beneath it, which at a short distance is either arrested in a cul-de-sac, or passes from one auricle into the other. The latter is the more frequent. Da Costa Alvarenga found obliteration complete in 8 cases only out of 213.

Robert Barnes had made similar observations. But it does not follow that, because an anatomical communication may exist between the two auricles, the blood must pass from one auricle to the other. During the auricular systole, the blood presses the valve over the opening, thus opposing a mechanical barrier; and at the same time the physiological impulse directs the current of blood from each auricle into its corresponding ventricle. It is quite possible even for two streams, each having its proper destination, to run side by side without a septum, to preserve themselves from admixture. We see examples of two streams running side by side in the confluence of rivers. When the physiological attractions and impulses are disturbed and anatomical defects are marked, then the streams are apt to mingle.

Obliteration of the Ductus Arteriosus.—This takes place nearly at the same time as that of the foramen ovale. The recent observations of Walkhoff, verified by Parrot, show how it is effected. From the second day the middle coat becomes thickened by the nuclear proliferation of its fusiform cells. The inner coat undergoes a similar change; the nuclei of its epithelium and of its superficial connective layer multiply so as to form a triple row, giving to the canal a velvety aspect. On the fifth day the proliferating elements of the middle tunic push the internal tunic inwards, forming longitudinal folds. Fibrinous concretions complete the closure of the canal about the fifth day. The ductus arteriosus is thus converted into a ligament, in which are sometimes found hæmatoidine and carbonate of lime.

At the same time that these phenomena of obliteration and atrophy take place in certain branches of the circulating system, other vessels open up to deliver the blood freely to its new destinations. Thus, the trunk of the pulmonary artery sensibly enlarges, because the blood, which previously passed through the foramen ovale and the ductus arteriosus, must all go into the pulmonary artery and its divisions to reach the lungs. The pulmonary veins, which bring back the blood from the lungs to the left auricle, undergo corresponding development.

The digestive organs, inert during fœtal life, enter upon function, and then the corresponding vessels—the system of the vena portæ particularly—enlarge considerably.

The left ventricle, which during fœtal life was thinner than the right, grows rapidly, and soon acquires the relative thickness which is observed in adult life.

The arterial tension of the new-born child corresponds, according to Vierordt, to 111 millimetres of mercury—that is, sensibly less than in the adult, in whom it corresponds to about 200 millimetres.

The Pulse in the New-born Child.—Billard, Jacquemier, Trousseau, Valleix, Parrot, have studied this subject. The radial artery is hard to feel; one must auscultate the heart. Trousseau says it beats about twice as quickly as in the adult—that is, about 137 in the minute during the first two months; 128, from two to six months; 120, from six months to a year; 118, from one year to twenty-one months. Sleep or wakefulness affects it. It may be 142 when awake, and only 124 when asleep. Parrot found that the pulse was liable to great variations under the influence of movements, crying, and external impressions. The pulse is less frequent in vigorous children

than in delicate ones. In healthy new-born children the pulsations are regular, strong, clear, and uniform. When they are accompanied by a *bruit de souffle*, there is a fault of structure of the heart, as persistence of the foramen ovale, or a communication between the two ventricles.

THE BLOOD OF THE NEW-BORN INFANT.—The *quantity* is estimated by Welcker at nearly $\frac{1}{20}$ of its body-weight, whereas in the adult it is $\frac{1}{13}$. The *specific gravity* is also less. Denis found it to be between 1045 and 1049, whereas in the adult it is from 1052 to 1057.

Professor Hayem[1] has studied the characters of the blood. At first, by the naked eye, it is seen that the blood flowing from the cutaneous capillaries is black, like the venous blood of the adult. This color, very evident in the child which has made but a few respirations, diminishes in depth in a few hours. The same character is manifested in the dark-purple face of the new-born before it has breathed well, and the rapid change to a brighter hue as soon as respiration is established. This dark color may, however, not be so marked in the fœtus whilst it enjoys placental respiration. It may be transitional, existing only during the interregnum between the loss of the placental action and the establishment of aërial respiration. But the blood is still darker than in the adult ten days after birth.

The red globules are much less uniform than in the adult. The largest exceed the largest of the adult, the smallest are smaller. Otherwise expressed, we meet *giant* and *dwarf* blood-corpuscles. These globules are found in varying proportions from day to day. Hayem and Cadet found the red globules more numerous than in the adult. Neumann says that a certain number of red globules possess a nucleus. The hæmoglobin is of about equal value in the new-born and the adult.

At the moment of birth, the white globules are smaller and much more numerous than in the adult—that is, about one white globule to 300 red in the new-born, against one in 800 in the adult.

The *hæmatoblasts* resemble those of the adult, but are much less numerous—that is, 33 times less numerous than the red globules in the new-born, against 19 times less in the adult. During the first days—that is, whilst the child is losing weight—the number of white globules falls to 6000, or even to 4000, whilst that of the red globules rises; then an inverse movement takes place, so that in the second week the white globules have risen to 7000 or 9000, and the red globules have fallen by 500,000. In short, whether we look at the globules, white or red, or the hæmatoblasts, all the elements show constant variations of form and number—signs, as Hayem says, characteristic of blood in the process of evolution.

RESPIRATION.—A healthy child as soon as it is born breathes and utters a cry. What is the cause of the first inspiration? Marshall Hall contended that the first respiratory movement is a reflex act provoked by the contact of the air upon the skin of the fœtus as it emerges from the mother. Vierordt contended that it is due to excitation of the medulla oblongata by blood charged with carbonic acid in excess, in consequence of the suppression of the placental respiration. This explanation is supported by the fact that during intrauterine life the fœtus makes inspiratory efforts when threatened with asphyxia. Robert Barnes believes that both factors, and that yet a third, are concerned. Thus, (1) the fœtus, failing to receive purified blood from the placenta, tries to breathe, whether still in utero or not; (2) the influence of air upon the respiratory nerves is too obvious and familiar to be disputed; (3) the sudden liberation of the child's chest and abdomen from the compression to which they are subjected during the final act of

[1] Comptes rendus de l'Acad. des Sciences, 1877.

labor, involves a rapid expansion of the chest-walls and abdomen, setting up a vacuum suction action. This is illustrated by what occurs in the practice of the various methods of inducing artificial respiration. The concurrence of these three factors is almost constant.

In any case, the air penetrates into the lungs, and if auscultation be practised at this moment, as Tarnier and Cornil discovered, a fine crepitation-râle is heard, probably due to the opening out of the pulmonary alveoli.

The respirations are more frequent in the new-born than in the adult. Great variations are observed. Parrot found the respirations in 22 sleeping children to give a mean of 51.54, and in 12 waking children, 51.16. That is slightly more frequent during sleep. It was nearly equal in boys and girls.

The respiratory *type* is the *abdominal* at first. The enlargement of the chest is mainly effected by the descent of the diaphragm; the anterior abdominal wall becomes strongly convex at each inspiration. Depaul says that during waking the respiration is more costal.

Bouchaud estimates at 45 grammes in 24 hours the pulmonary exhalation in a child five days old.

The temperature is best taken by placing the thermometer in the rectum. At birth the temperature is 37.25° Cent., slightly in excess of that of the mother's vagina; but Parrot says it is a little less than that of the uterus, which under the influence of labor rises to 38°, 38.5°, or more. In any case, the temperature falls sensibly during the half-hour following labor, and this fall is more marked in proportion to the debility and immaturity of the child. The new-born has little innate power of generating heat; it depends greatly upon the supply of external warmth. In the Paris Maternité Tarnier puts weakly and immature infants into a specially constructed "couveuse" or "incubator."

In healthy children the temperature soon rises as the respiration becomes established, and reaches to 37.5° or 37.6° Cent. Tarnier insists that, the pulse being so variable, the observation of the temperature is especially valuable as a test of fever in the infant.

Digestion.—The act of suction consists in the grasping the nipple by the upper jaw and lip above, and by the tongue and lower lip below; the palate being lowered and closing the mouth behind, aspiration is effected by a movement of the tongue and lower jaw, which make a vacuum by being drawn back. The cheeks are seen to fall in between the alveolar arches. The milk then comes into the mouth, the cheeks become distended, the child swallows, and a sound is heard during deglutition. Failure in the integrity of any of these organs defeats the production of a vacuum. Thus harelip and cleft-palate may lead to starvation. Milk hardly undergoes any change in the mouth. But an interesting practical question arises, whether starch-foods are susceptible of transformation into sugar under the action of the saliva, as in adults under the influence of ptyaline. Burdach, Joerg, Bidder, maintained that for six or eight weeks the salivary glands were so little developed that they could hardly secrete any saliva. Vogel contended that there is enough saliva to act in a small degree; and Zweifel, by separate observations on the different glands, found that ptyaline existed only in the parotid glands in the infant at term, the submaxillary glands developing it later. In any case, the power of transforming starch into sugar is feeble, and the indication is clear against cramming the infant with pap.

Stomachal Digestion.—The stomach of the new-born infant is of small capacity. Fleischmann estimates it at 46 centimetres during the first week, at 72 to 82 during the second week, at 80 to 92 during the third and fourth weeks, at 140 in the third month, at 260 in the fifth month, at 375 in the

ninth month. But the variations are great. At birth the direction of the stomach is nearly vertical, instead of horizontal as in the adult, so that the food passes rapidly through it, when the child is held upright. Its muscular walls are as yet very little developed. Hence food should be given in small quantities and at short intervals; and albuminoid foods should be of easy digestion, since they remain for so short a time in the stomach.

In the stomach the milk is coagulated by the gastric juice, and the whey is separated from the fat and caseine. The whey or serum is directly absorbed. The caseine and other albuminoids are transformed into soluble substances, easily assimilable. Zweifel and others have shown that the albumen of the egg is more difficult to digest than caseine; and what is very important, this substance itself is less easy to peptonize if it comes from cow's milk than from woman's milk. An excess of acidity of the gastric juice may also cause large clots of caseine hard to digest. The acid of the gastric juice can dissolve the gelatinous substances sometimes given; also the salts of lime, the absorption of which is useful for the development of the osseous system. It has also the property of preventing putrefaction.

The sugar of milk is transformed by the stomach into grape-sugar, but the tranformation is chiefly effected in the intestine.

Intestinal Digestion.—The albuminoid substances not dissolved in the stomach pass into the duodenum, where the pancreatic juice changes their reaction from acid to alkaline, and then dissolves them by peptonization by a ferment called by Kühne *trypsine*. Zweifel showed that the pancreatic juice dissolves albuminoids, but has not the power of transforming starch into sugar. He also showed that, as in the adult, the pancreatic juice possesses the property of making an emulsion of fats, and of converting them into acid fats and glycerine.

It shares the property of making fat emulsions with the bile, which is poured into the duodenum along with it, and which is probably abundant, for the liver is very large, and bile elements are found in great quantity in the feces.

When bile and pancreatic juice are deficient, the fatty matters are not completely absorbed, and are found in the stools. Then are seen the *fatty stools* described by Wegscheider.

Absorption is very active in the small intestine, on account of the villi and the numerous folds of the mucous membrane.

Bile prevents putrefaction of the contents of the intestine in an alkaline medium, as the gastric juice did in an acid medium in the stomach. The rapid transit of the food also obviates putrefaction. Hence the stools of infants are almost inodorous, unless the order and relation of the processes named are disturbed.

The Evacuations.—At the end of fœtal life there is an accumulation in the large intestine of a substance called meconium (from *μήκων*, poppy), from its resemblance to poppy juice. It is a viscous matter of bottle-green color. It is formed of a mixture of mucus, epithelial cells, and of bile-matters, which keep it from putrefaction. It is not generally voided before birth. Evacuation is a respiratory act. So when breathing is established, the diaphragm and abdominal muscles contract and empty the bowels. The exceptional cases of meconium evacuation before birth will be described in connection with breech-presentations, head-first, and other labors, where the circulation has been interrupted.

The meconium is for the greater part voided during the first twelve hours, but the expulsion goes on for three or four days. Depaul estimates the quantity of meconium in the intestines at birth at 74 grammes.

When all the meconium is voided, the stools contain the residuum of

digestion, and vary according to the diet. When the child is fed from the mother's breast, and colostrum or colostrum and milk form its food, the stools are of light consistence of light green color, and these characters may persist for some weeks. When a child is taken to nurse by a woman whose milk secretion is fully established, the colostrum period being passed, it is not rare to see the stools yellow during the first days.

When the digestion is good the stools are bright yellow, of the consistence of thick soup, homogeneous, odorless. The color is due to the coloring-matter of bile, bilirubin.

Sometimes the stools are greenish when voided, or become so on exposure to the air. This is a sign of bad digestion. The color is due to biliverdin, and in this case we find small quantities of the bile acids not transformed, such as acids of the formic group—capric, stearic, palmitic. There is a sour odor like that of sour milk. Sometimes this condition is corrected by alkalies, as of lime or soda, which, neutralizing the acids, prevent the oxidation of the bilirubin and its transformation into biliverdin. But sometimes it is necessary to change the food.

The *feces* of infants at the breast are usually homogeneous, consisting of different substances well mixed—epithelial débris, mucus, caseine, neutral fats in the form of fat globules. If the stools are mixed with water, these globules rise to the surface.

Sometimes there are found in the stools large whitish flakes, not intimately mixed with the other ingredients. This happens chiefly under the use of artificial food. These flakes are a "sign of imperfect digestion, either from the food being unsuitable or too plentiful." These flakes have been looked upon as coagula of caseine, but Wegscheider says they are formed entirely of neutral fats mixed with epithelial débris.

The number of stools in a healthy infant is two to four daily at the beginning, and later one or two. Marked deviation from this standard, either in excess or deficiency, is evidence of disordered digestion or of unsuitable food.

Reichard found the dry residuum of the stools after evaporation to be about fifteen per cent. in an infant of three months. In the dry residuum Simon found among other substances in a child six days old fifty per cent. of fat and eighteen per cent. of caseine.

THE URINE.—At the moment of birth the bladder always contains a certain quantity of urine, unless the abdomen have been compressed during labor, as it is in breech-presentations, and unless the fœtus have suffered compression. In the latter case the sphincters relax and the urine and meconium escape. Under ordinary conditions the urine is voided within twenty-four hours of birth, sometimes immediately after birth. The first micturition amounts to about 10 cubic centimetres. During the next two or three days the quantity is small, because the quantity of milk absorbed is small. Bouchaud estimated that 643 grammes of urine passed corresponded to 1000 grammes of milk imbibed.

During the first days, whilst the child is losing weight, the color of the urine may be as deep as in the adult; but it soon becomes pale-straw, or nearly colorless. The first urine has a density of 1005 to 1006; later it falls to 1003 or 1004.

The Urinary Deposits.—The urine of the new-born infant deposits 1st, epithelial cells from the inner surface of the urinary apparatus, bladder, ureters, pelvis, and tubules of the kidneys; 2d, crystals of uric acid, in small rhomboidal plates, transparent; 3d, oxalate of lime in octahedra; 4th, oxalate of soda in ovoid rods or spherules.

Chemical Characters: G. Sée contends that the analysis of the urine can

give more precise information as to the nutrition of the infant than weighing it. The *reaction* of the urine in healthy infants is neutral. If found acid, Parrot submits that the child is out of health.

The Quantity of Urea.—The urine of the new-born infant contains urea, but in such small proportion that its existence has been contested. On the third day it becomes more obvious, and it increases in quantity after the tenth day, so that between two and five months the daily excretion rises to 3 grammes, and in the third year to 14 grammes, or about half the quantity passed in adult life. This is the statement of Martin and Ruge, but Parrot and A. Robin have arrived at somewhat different results; they, however, agree that the quantity of urea excreted increases after the tenth day. Parrot says that an infant kept in a warm medium excretes more urea.

Uric acid is found in the urine of infants at the breast. It increases during the first days, then diminishes, then again increases and becomes more copious than in the adult.

Uratic Infarctus in the Kidneys.—A remarkable condition sometimes found in the kidneys of new-born children is the uratic infarctus. Concretions of uric acid salts are found in the form of small yellow cylinders, filling the tubes of the pyramids near the hilum. When the summit of the pyramids is squeezed, a yellowish dust comes out. A similar dust is found in the calices and pelvis, in the bladder, urethra, and sometimes even on the prepuce. Virchow says these uratic infarctuses are composed of crystals of urate of ammonia. Parrot demonstrated them to consist of urate of soda. Virchow regards them as physiological. Parrot thinks they are the result of athrepsia. He says in this affection there is insufficient combustion of the waste-stuff of nutrition, for the hæmatosis, much weakened, does not bring oxygen in the necessary quantity for this combustion. The elements of disassimilation, instead of being transformed into urea, remain in the state of uric acid. On the other hand, in athrepsy the vomiting and diarrhœa entail a considerable loss of water of the blood, so that there is not left enough to dissolve the salts which result from the combination of the uric acid with the soda. Thus the salts form the deposits described. It is a pathological phenomenon. These concretions are not found in healthy children.

Vierordt also notes in the urine of the new-born a substance distinguished as *allantoin*, a product of the oxidation of uric acid, but to a less degree than urea. Allantoin is found only during the first days; it disappears in the second week under the form of urea.

Dohrn found traces of *albumen* immediately after birth. It is more abundant in children who endured disturbances in the circulation during labor, and especially in the still-born. Parrot and A. Robin say the urine of healthy infants is free from albumen.

Pollak says the urine of children at the breast contains small quantities of *grape-sugar;* but this has not been confirmed.

Inorganic Substances.—Chlorides, phosphates, and sulphates are found. The urine of the new-born holds faint traces only of chlorides and sulphates.

Modifications of the Skin in the New-born.—These may be classed as changes of color, desquamation, and cutaneous excretion.

Color.—The fœtus at birth is covered more or less completely with a greasy, whitish matter, which may hide the color of the skin. When the child has fairly breathed, the skin is light, or even deep, red. This tint lasts three or four days, gradually fading; but it may last longer. It is more pronounced and lasting in delicate and premature children. This is the sign of difficulty in the circulation. It persists longest in the extremities, which are bluish. Often about the third day it gives way to a subicteric tinge. Most frequently this is not icteric, but is due to transforma-

tions in the coloring matter of the blood, which fills the cutaneous and subcutaneous tissues—that is, to a *hæmapheic jaundice.* In the more severe forms of jaundice there seems to be a strong hereditary tendency. Robert Barnes saw a child whose parents were apparently healthy, which died a few days after birth of jaundice, gradually increasing in intensity. This was the eighth child in succession, all of which died in the same manner.

Children born of black parents are not at first black of skin. It is chiefly at the umbilical ring and on the scrotum or labia majora that black pigmentation is observed.

Sometimes *nævi materni* are seen. We do not speak here of those nævi of pathological significance, but of spots which appear in many children, and which disappear spontaneously after a short time. They are of deeper red than the rest of the skin, are effaced under pressure, and seem due to increased vascularization. They are not raised above the skin-level, are irregular, often multiple, and are principally seen on the eyelids, on the face, forehead, and lips. They almost always disappear in a few months.

Occasionally we see on the skin of the face a kind of sebaceous acne formed during the later months of intrauterine life.

Desquamation.—Soon after birth, the skin cracks and forms shreds of epidermis, which soon separate. Sometimes this exfoliation is effected in small scales, as in the furfuraceous desquamation of rubeola. Parrot says, "it appears in premature children very slowly, whereas in those born at term it sets in on the first or second day, and is in full activity on the third or fifth. It is completed at variable dates from the thirtieth to the fiftieth day. It is most marked on the chest and belly."

The old epidermis is succeeded by one of new formation. Sometimes, in the axilla, the new epidermis is still imperfect whilst the shreds of the old are being cast. Thus there results at times an oozing, or even a true intertrigo. Depaul has observed cases in which desquamation began before birth. These cases must not be confounded with those of maceration of the epidermis of dead children in the liquor amnii.

Cutaneous Excretion.—The epidermic desquamation is in relation with the new functions which the skin has to perform. Perspiration, hitherto wanting, is about to be established. The sweat-glands are but little developed. But occasionally new-born infants wrapped in cotton-wool perspire pretty freely.

Bouchaud estimates at 55 grammes in twenty-four hours the transpiration of an infant after the eighth day.

THE LACTEAL SECRETION IN THE NEW-BORN.—A phenomenon is occasionally seen to which nurses, especially the more ignorant, attach great importance—the formation of milk in the breasts. Natalis and Gubler consider this as a constant and normal process. It is usually established about the fourth to the tenth day. De Sinéty[1] has carefully studied the subject. The breasts swell, sometimes become red—that is, the glands inflame, and abscesses may result. According to our observations, this result is commonly due to the meddling of the nurse, who thinks the milk ought to be squeezed out. But in normal cases slight pressure will bring out a little oozing from the nipple, which has all the appearance of milk from the adult. This may last for a month or more. It is observed in both sexes alike.

Chemical analysis of this milk, called by the Germans "Hexenmilch" (*witches' milk*), has been made by Quevenne (see Gubler[2]). It is shown that this liquid contains all the principal substances of woman's milk—butter,

[1] Recherches sur la mamelle des enfants nouveau-nés. Arch. Physiologiques, 1875.
[2] Société de Biologie, 2ème Série, t. II.

caseine, sugar of milk. It shows epithelial cells in fatty degeneration, fat-globules. De Sinéty says the epithelium cells appear first and correspond to the colostrum period, and that the fat-globules appear next and correspond to the secretion of true milk.

INCREASE OF WEIGHT.—The new-born commonly loses weight during the first two or three days, or until it gets a fair supply of food. What is the standard weight of a child? It is difficult to state it. Healthy children, at term, range from 6½ lbs. to 8 or 9 lbs. But cases are met with in which lesser and greater weights are noted. New-born children below 6½ lbs. may be reasonably suspected of being premature. On the other hand it is difficult to assign a maximum weight—10 lbs. is the weight of a very large child; 12 lbs. make a littte giant; and Robert Barnes weighed a new-born infant which turned the scale at 17½ lbs.; it was still-born.

Boys weigh, on an average, more than girls. The weight also varies with race. Our American cousins contend that they produce the biggest children.

The loss of weight on the first day is due mainly to the discharge of meconium and urine and to pulmonary and cutaneous exhalation. On the second day the pulmonary and cutaneous exhalation may be even greater, and there is a further loss by absorption of fat. This continues until food is adequately assimilated. Then the child begins to gain weight. We believe that it has commonly regained the weight it had at birth at the end of a week. The children of pluriparæ generally pick up more quickly than those of primiparæ, because the first secrete milk more readily. Tarnier says children given to nurse by a woman whose milk secretion is established grow at first more quickly than if nursed by their mother, whose milk is in course of evolution. Ribemont-Dessaignes says the delayed ligature of the cord favors the rapid growth of the child, and ought for this, amongst other reasons, to be preferred to the immediate ligature.

TABLE SHOWING THE DAILY GROWTH OF THE NEW-BORN (TARNIER).
SCALE, GRAMMES.

Month.	Bouchaud.	Bowditch.	Albrecht.	Heischmann.	Beldert.	Mean
	Gram.	Gram.	Gram.	Gram.	Gram.	Gram.
1	25	35	30	35	28	30.6
2	23	32	29	32	39	31.0
3	22	28	29	28	30	27.4
4	20	22	24	22	24	22.4
5	18	18	20	18	16	18.0
6	17	14	18	14	11	14.8
7	15	12	14	12	11	12 8
8	13	10	11	10	13	11.4
9	12	10	11	10	12	11.0
10	10	9	9	9	5	8.4
11	8	8	8	8	5	7.4
12	6	6	7	6	3	5.6

Looking at the last column of means, especially, it is seen that the daily gain lessens every month until the end of the first year. Practically, it is enough to know that a child ought to gain from 30 to 20 grammes daily during the first four months, 20 to 10 during the succeeding four months, and 10 to 5 during the concluding four months of the year.

These figures are important. If the gain falls much below the *minima*, something is wrong with the child, its food, or the care taken of it.

A child in good health, well fed, and properly tended, grows rapidly; its

gain from day to day is perceptible to the eye; its figure is plump; its body firm; its skin is full; its buttocks prominent, firm, and studded with little hollows or pits; the skin in this region is red, almost violet, mottled.

In France the balance is greatly resorted to as giving precise indication of the condition of the child. The weighings should be made weekly when the child is apparently healthy; daily when it shows signs of falling off. Allowance must be made for loss by evacuations. The weights may usefully be recorded on charts similar to those used for temperature-records. The trial by weight is often appealed to in medico-legal investigations.

Growth of Child in Size.—Quételet (1833) found the mean growth in stature was 40 millimetres in the first month, 30 in the second, 20 in the third, and from 10 to 15 in each of the succeeding months. Bouchaud arrived at nearly identical results.

Growth in Stature.—Table after Tarnier.

During the 1st month	40 millimetres.
" 2d "	30 "
" 3d "	20 "
Each succeeding month	10 to 15 "
Of the 1st year	198 "
" 2d "	90 "
" 3d "	73 "
During each of next two years	64 "

This growth is not evenly distributed over the body. The head, which is relatively large at birth, grows more slowly in proportion to the limbs.

Modifications of the Sutures and Fontanelles.—In the healthy new-born the sutures and fontanelles enlarge at first, and lessen when the child is the subject of athrepsy. According to Elsaesser, the width of the greater fontanelle at birth averages 21.6 mm., and reaches 31.3 mm. at the ninth month. From this time it contracts, and in the second or third year it disappears, except in rachitic or hydrocephalic children. Sappey says the posterior and lateral fontanelles are obliterated in the first year.

Observation of the fontanelles supplies valuable clinical indications. If there is marked depression malnutrition may be suspected. If, on the other hand, the brain rises fairly to the due level, the child is fairly nourished.

Care of the New-born Child.

As soon as the child is expelled from the vagina, any coils of cord round its neck or body should be untwisted. The attendant having then placed the child close to the mother, so as to avoid any strain on the cord, should cleanse its mouth from any fluids, such as blood and mucus, it may have partially swallowed during its passage through the vagina. This should be done at once, as such fluids drawn into the lung vesicles may give rise to inflammation of the lungs, or even septicæmia.

When the child has cried out freely, the umbilical cord may be divided and the child wrapped in flannel and entrusted to a nurse. The cord is ligatured with stout thread in two places; the first about two or three inches from the umbilicus, the second two or three inches beyond the first spot. It is then divided between the two ligatures. Nearly all obstetricians now wait for a few minutes after the birth of the child, until the pulsations in the cord have slowed down and become feeble, before proceeding to tie it. Budin and Ribemont-Dessaignes have shown by experiments that ligature of the cord immediately after birth deprives the child of a considerable quantity

of blood which it derives from the placenta as long as the pulsations in the umbilical cord are distinct. It is usual to wrap the child in a warm blanket and place it on the bed or sofa, until the binder has been applied to the mother and the draw-sheet has been removed. This being done, the child should be washed from head to foot in warm water. In giving the child its first bath it is not necessary to endeavor to rub off all the vernix caseosa. If soap is freely used, what remains will disappear at the second or third bath.

As soon as the child has been dried, the part of the cord which has been left attached to the umbilicus is wrapped in a piece of clean, dry linen, lightly charred, and a belly-band is then wrapped round the child's abdomen.

When the child is dressed it may either have one or two teaspoonfuls of warm sugar and water, or it may be placed, if the mother intends suckling, to the breast. The new-born child requires external warmth, and it is especially necessary during the first days of its extrauterine life to keep it warm and protected from draughts. In weakly children the temperature has been observed to fall as low as 33° C. in half-an-hour after birth. This indicates the small amount of intrinsic heat in the new-born child.

The clothing should be light and warm, and at the same time not so tight as to restrain the free natural movements of the child. It is well to avoid tight bandages round the abdomen; they impede the due descent of the diaphragm, and thus prevent the lower air vesicles receiving their full complement of air. In cases of umbilical hernia, where the use of a pad is necessary, a somewhat constricted bandage is necessary. It is better that all the clothes should be made to fasten with strings instead of pins. If pins must needs be used, let them be of the kind known as "safety pins." The arms, shoulders, and legs should be covered. The napkins which it is usual to wrap between the buttocks for the reception of the child's excrements should be changed immediately they are soiled either by feces or urine. Neglect of this act of cleanliness results in excoriations and eruptions of the skin, which wear the child's nervous energy and lower the state of its health. It is a good thing to see that the temperature of the child is normal from time to time. If, for instance, the temperature is found to be subnormal for several days in succession, it is probable that it is not sufficiently warmly clad. Clothing should then be added until the normal temperature is reached.

The Causes and Prevention of Ophthalmia.—Of late years a practice has been strenuously urged and extensively practised of applying nitrate of silver to the eyes soon after birth, with the view of preventing ophthalmia. The practice is based upon the hypothesis that ophthalmia is caused by the infant's eyes coming in contact with irritating discharges, whilst in transit through the vagina. It is further assumed that generally, if not always, the offending matter is gonorrhœal. That this hypothesis is true in a certain proportion of cases we have no doubt. But that it is exclusively, or even in most cases, true we do not believe. We have assisted at the labor of a lady who, we were able to say positively, was free from all unhealthy discharge; the child was, moreover, born in the unruptured bag of membranes, the ovum, placenta, and all, being expelled entire. The child was taken out of the sac by clean hands. Neither our hands nor the child ever came in contact with the mother's parts. Yet four days afterwards ophthalmia appeared. Again, cases have been reported of ophthalmia in children delivered by Cæsarean section. The real source of mischief is not far to seek. It is found in the use of sponges and towels that have not been properly cleansed. "Things from the wash" are a fruitful source of danger to the child as w as to the mother. The sponges used for the child should be scrupulou

disinfected, and towels for washing as well as the diapers should be was at home, or disinfected before being used. If care in this respect be ri ously observed, and if the nurse will disinfect her hands after attendin the puerpera, we are convinced that ophthalmia will be extremely rare, that the barbarous plan of indiscriminately swabbing the child's eyes caustic may be discarded.

Erysipelas, starting from the navel, may in many cases be suspecte have been communicated by the foul sponges or other modes of contact infection.

Milk as Affected by the Food and Medicines taken by the Mother.

1. MILK AS AFFECTED BY FOOD.—As a general fact, it is true that the a certain relation between the food taken and the quantity and qualit the milk produced. This is well understood in the case of cows. The m produced by cows kept in stalls and fed chiefly on brewers' grains, a pro which seems to stimulate the secretion from the breasts, is certainly infe in quality to that yielded by cows fed on hay or grass in the country.

Somewhat analogous to the stimulation of milk in cows by brewers' gra is the stimulation of the secretion in women by drinking stout. It is a wi spread belief in this country that nursing women require an abundant supp of stout. It is certain that many women thrive upon it, and keep up th supply of milk. But many others are injuriously affected by it. Perha they take too much, absolutely and relatively. Women accustomed to ha work may digest one or two quarts of stout a day, and yield good mil Others will do better on a single pint. In every case it is desirable to reg late the allowance, strictly beginning with the smallest quantity that can used with advantage. And it must not be forgotten that some Engli women, and most women of other nations, nurse well without any sto Women accustomed to wine may take that to which they have been accu tomed, carefully observing moderation.

A decisive objection against any excess in alcoholic drinks by nursi women is that the child is likely to be injuriously affected. Alcohol pass into the milk. "*Ebrii gignunt ebrios.*"

The simpler the diet of the nursing woman the better. Plainly dress mutton, beef, poultry, fish, light combinations of butter, eggs, and mil bread and other farinaceous articles, should form the staple. She general requires more fluid than in the ordinary state. This unusual demand is be met by milk, water, plain or aerated. Tea and coffee should be taken moderation, and not strong. Cocoa is at times useful.

The nursing woman should take regular exercise in the open air wh possible. She should avoid chills, and be guarded against mental pertu bations. No one secretion can go wrong without entailing disorder in t rest. Therefore, care should be taken to regulate the action of the bowe preferring some mild aperient, as the compound liquorice powder, or t Hunyadi-Janos, Friedrickshall, or Æsculap waters.

Should the woman show symptoms of acute or chronic dyspepsia, the mi is sure to be charged with some of the products of badly digested food; a the child will be likely to suffer. Pains in the stomach from colic, evinc by drawing up the legs, tension of the abdominal muscles, crying, vomiti and diarrhœa, the stools being greenish and curdled, are sure signs of food disagreeing. In such a case treatment must be directed to the moth as well as to the child. And in this treatment temporary lowering of t diet, especially of stimulants, is the most essential point.

2. Milk as Affected by Medicines.—All medicines probably, taken in physiological or poisonous doses by the mother, pass into the milk, and may affect the infant at the breast, Robert Barnes has detected iodine in the milk when given to the mother. Thus given, a syphilitic suckling may be cured. Quinine, so useful to the mother, has sometimes to be given up because it gripes the child; and so it is with colocynth.

It is possible that doses that act only physiologically on the mother may act poisonously on the more susceptible organization of her nursling. This applies more especially to the convulsive and narcotic poisons.

The Choice of a Wet-nurse.

Trousseau especially insisted—

1. That a nurse should already have reared one child. A cow at the third calving gives more milk. A woman who has previously suckled is likely to have better developed breasts. When phlegmon of the breasts has previously occurred, it may be presumed that a part of the gland has suffered in its texture, and that a repetition of the abscess may occur in future lactations. Whereas, if a woman have suckled one or two children without mischance, she may be considered safe. She may, in short, be held to have proved her bodily soundness by this capacity for lactation, the final act in the process of generation.

2. The nurse should have been delivered six or eight weeks, because fissures and the consequent inflammations mostly declare themselves before this time.

In selecting a wet-nurse the examining physician has the following additional points to bear in mind: When was her last confinement? Who attended her? Has he any previous knowledge of her health or habits? To make a careful physical examination of the nurse and her baby. To verify the amount of milk in both breasts. To determine its quality. To look for evidences of consumption, or scrofula, as well as signs of syphilis, such as primary sores, mucous patches, enlarged glands, loss of hair, Hutchinson's teeth. Lastly, is her health, in all respects, such as would fit her for wet-nursing, and is her baby healthy? Natalis Guillot estimates that a nursling draws from the breast an ounce and a half or two ounces during the first month, eight to ten ounces during the third month, thirteen to fourteen when twelve months old. These estimates were deduced from weighings of the child. The method is not free from fallacy. The quantity allotted to the first month is certainly underrated.

Substitutes for Breast Milk.

A good substitute is asses' milk. This can be given with only slight dilution. Cows' milk comes next; this must be diluted with one-third part of warm lime-water and slightly sweetened.

Great care is necessary in having it drawn twice a day, and keeping it in a cool place, or in ice, covered over. Where it cannot be had in fresh supplies at short intervals, it is necessary to heat the milk to near the point of boiling. Perhaps, however, the nearest approach to human milk is the condensed mares' milk, as introduced by Dr. Carrick. It is, indeed, almost identical in its constituents with human milk. For several years past it has been extensively used with good results in the foundling hospitals at St. Petersburg and Moscow. Fancourt Barnes has also employed it in his wards in the British Lying-in Hospital, and has found it answer in a very satisfactory manner.

Next to the fresh milks come the various forms of prepared milk. Of these that in most general use is the Swiss prepared milk.

THERE IS NO SUBSTITUTE FOR MILK.—It is the only all-sufficient food. It therefore forms the staple of all the artificial foods for infants which are of real value.

The differences between colostrum and milk are that in colostrum the corpuscles cannot mix intimately with the serum, whilst in milk the fatty droplets form a true emulsion in the serum. Moreover, colostrum coagulates in boiling, which proves that it contains albumen, whilst milk does not possess this property, because the albumen has been transformed into caseine.

THE CHEMICAL CONSTITUTION OF MILK.—According to the analyses of Becquerel and Vernois, milk contains, in 1000 parts, 889 of water and 111 of solid matter, of which 39.24 are caseine, 26.66 butter, 43.64 sugar of milk, and 1.38 inorganic salts, amongst which is phosphate of lime.

The specific gravity varies a little.

The reaction is alkaline.

Asphyxia Neonatorum.

The first point of interest in the new-born child is to determine whether it be alive; the next is to determine the prospect of its thriving. In the great majority of cases, all doubt upon these points is quickly removed by the child's crying vigorously and moving its limbs. But in some cases these evidences of robust life are wanting or delayed.

In some of these latter cases the child is really dead—still-born. In others animation is suspended. It is of instant importance to verify these conditions, in order that proper measures may be promply taken to nurse, sustain, and establish the flickering flame of life. "*Latet scintillula forsan*" was Marshall Hall's favorite motto. Let it be ours; it is the most hope-inspiring stimulus to endeavor to rescue a life trembling in the balance.

WHAT CONSTITUTES LIVE-BIRTH?—The question seems to carry its answer. But in practice the answer is not always easy. The question is of extreme importance in its forensic relations. For example, infanticide cannot be committed upon a still-born infant. A still-born infant is buried under different regulations from a live-born one.

There are several tests of live-birth. Live-birth is proved by the existence of any of the known functions of life; as movements depending upon nervous and muscular action, the pulsation of the heart, and respiration. It is obvious that any one of these movements is a vital act. Respiration may be wanting, but the pulsation of the heart may continue for some time, and so long as it lasts it offers presumptive evidence of such life in the nervous centres as may be appealed to with the view of full restoration. The heart may practically be regarded as the "*ultimum moriens*." The heart of the frog, for example, may continue to beat for some minutes after removal from the body. It might be argued from this fact that it possesses an independent *vis insita*. But this must be of short duration.

A stronger proof is the establishment of respiration. This test has a certain practical convenience. When breathing takes place the evidence of life is manifest and incontestable. It bears, moreover, evidence of its accomplishment after death in the condition of the lungs and of the chest-walls. A strong objection to accepting this as the only absolute test lies in the fact that respiration is frequently started spontaneously, or under treatment, after many minutes, even half an hour after birth; the only evidence of life up to this moment being the beating of the heart. Now to accept breathing

as the only test would entail this dangerous conclusion, that if the infant be strangled, so as to prevent its breathing, there is no murder. The law accepts any distinct evidence of life; and to destroy even an immature and non-viable child which gives evidence of life is infanticide.

It is obvious, however, that life, even latent, cannot long be sustained unless respiration be established. The failure to breathe induces asphyxia.

We may recognize *three forms of asphyxia:*

A. *Simple Asphyxia.*—This may be defined or described as the state arising from interrupted hæmatosis or the arrest of the placental respiration before the establishment of lung respiration.

B. *Paralytic Asphyxia.*—In this case respiration is prevented by incapacity of the nervous centres.

C. The *asphyxia of imperfect development*, or *atelectasis.*

A. SIMPLE ASPHYXIA.—The chief causes of this form are: 1. Those arising *before birth*, or active labor, as: complete or considerable separation of the placenta; unintermittent uterine contractions from ergot; cyanosis or feeble hæmatosis of the mother, from disease, hemorrhage, or the moribund state. 2. *During birth.* In addition to those cases enumerated above, compression of the placenta, knotting or compression of the cord, as in prolapsus of the cord, twisting of the cord round the child's neck or body. The child's neck may also be compressed by the tight ring of the vulva retracting upon it when the head has passed. When this occurs the blood is prevented from returning from the head. The face becomes bloated, cyanosed; the child is in danger of being strangled.

Asphyxia of this kind is marked by lividity of the face, and perhaps of the body as well. It may be distinguished briefly as cyanotic or blue asphyxia.

B. PARALYTIC ASPHYXIA is produced by compression or other injury to the brain and medulla oblongata. This is especially apt to occur in labor with disproportion, under delivery by forceps or by turning. Syncope has been invoked to explain some of these cases.

In some of the fatal cases we find lesion of the brain, meningeal effusions of blood, or at least congestion of the pons Varolii and medulla oblongata. In such cases the face and skin generally are pale, the limbs are flaccid, there is muscular paralysis. These two forms may be recognized as pale asphyxia.

C. IN THE ASPHYXIA OF DEFECTIVE DEVELOPMENT the air-cells are not developed; there is *atelectasis*, and corresponding defects of the heart. This is the condition of premature and non-viable children. But it is occasionally observed in children at term.

The *symptoms*, *diagnosis*, and *treatment* of A. There is cyanosis or blueness and turgidity of the face and skin generally; flagging of the heart's action; twitching of the limbs in inspiratory efforts; sucking-in of circumambient fluids; perhaps evacuation of meconium and urine. If respiration is established, the cyanosis clears off, the skin becomes rosy, the infant opens its eyes. On page 389, we have related experimental observations in proof of the equivalence of placental and aërial respiration. The arrest of either kind of respiration entails like effects. Thus, Hecker, Krahmer, Schwartz, and others prove that where placental respiration is impeded, a spontaneous attempt by reflex action is made to substitute aërial respiration. Hüter relates a case (1856) in which the fœtus breathed and cried in an unbroken ovum. We find evidence of this attempt in the presence of liquor amnii, of fœtal epithelial scales, and meconium in the air-passages; and also in the appearance of ecchymoses or puncta of blood under the pleura and pericardium. This effort is the result of the accumu[illegible]f carboi[illegible]n the

blood. There is an instant want of oxygen, and the inspiratory act is excited to supply it. Our observations already referred to (page 389) prove the direct influence of respiration, whether placental or aërial, in keeping up the heart's action. Brodie long ago demonstrated that artificial respiration will keep up the heart's action in the adult animal. We have it then clearly established: (1) that the uterine contractions of labor, whether occurring spontaneously or artificially produced, lower the heart's action; (2) that placental or aërial respiration raises and sustains the heart's action; and (3) that, unless aërial respiration be kept up in the new-born child, the heart's action will speedily fail altogether. Here, then, we find the scientific basis for resorting to artificial respiration when natural respiration cannot be provoked.

Treatment.—In the greater number of cases there is no clogging of the air passages; there seems simply to be delay in effecting the first inspiration. The problem then is: how to start it. A main factor in producing the first inspiration we believe to be the expansion of the chest by resilition on the sudden liberation of the chest from compression as it emerges from the pelvic outlet; another is the *besoin de respirer*, produced by accumulation of carbonic acid in the blood, as the placental respiration is impeded in the first expulsive contractions of the uterus; a third is the diastaltic action excited by the contact of air and attendant evaporation of moisture on the skin of the face and chest. These give the indications for treatment. We may first appeal to the diastaltic function. 1. Blow upon the face; dash a little cold water on the face and chest; sprinkle a little brandy or other spirit on the chest, using gentle friction; flick the chest and buttocks with the corner of a wet towel; dip the child for a moment in water at 90° F. or nearly.

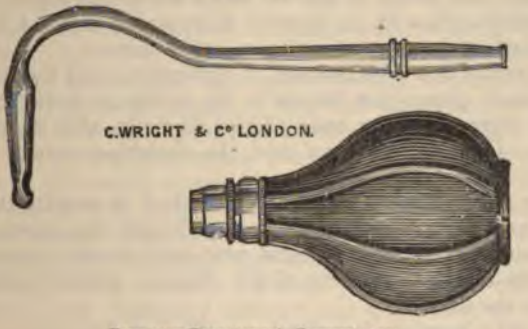
2. Reflex irritation failing, turn to *artificial respiration*. There are two principal methods: *a*. Direct insufflation into the lungs; *b*. Expanding the chest-walls to create a vacuum, which draws air into the lungs. The first method is the most ancient. It was first practised by blowing from mouth to mouth, with or without the intervention of a piece of gauze. It was found that the air often passed over the trachea and went into the stomach. A tube was then restored to, which was passed into the trachea, and served for insufflation. Two points have to be met. First, the surgeon should fill and empty his lungs several times deeply, so as to lessen the charge of carbonic acid in the air he is about to insufflate; and, secondly, insufflate very gently, lest the delicate air-vessels be burst. Several instruments compete for selection. In the "Obstetric Operations" we figured Richardson's apparatus. It consists of a double bellows of India-rubber uniting into one tube, at the end of which is a nozzle, which is introduced into one nostril of the child. The other nostril is then closed. Valves are so arranged that one ball acts for insufflation, the other for expiration. If it be feared that the air may not go into the lungs, you may compress the other nostril. Both balls are compressed simultaneously. Air is taken up by one and goes into the lungs; it returns by the ball which exerts a suction-action. Two things are important in working the apparatus: one, that the air be warm and dry; the other is, not to exert too much force. But Richardson insists that, if one nostril be left free, the air returning easily, undue pressure upon the vesicles is avoided. Our own experience with the apparatus is satisfactory.

Some form of tracheal tube has long been known. A tracheal tube was at one time a common companion of the obstetrist. The delicate air-vesicles are easily burst under insufflation; hence the necessity for extreme care in introducing air by the tube. The best insufflator appears to us to be Ribemont-Dessaignes's.

The laryngeal end is conical, and thus adapts itself to the cavity of the

larynx and prevents regurgitation of the insufflated air. In introducing the instrument, the left index is passed into the pharynx until it is behind the glottis; the instrument, held like a pen in the right hand, is then passed along the middle of the mouth until it reaches the bulb of the finger behind the glottis; the part of the instrument which remains outside the mouth is then slightly raised and the larynx is entered. The operator feels when the tube has entered far enough by the resistance opposed by the larynx, which fits closely round the upper part of the cone. The operation is best done with the child lying on its back. When the instrument is introduced it is best to aspirate at first any fluids in the trachea. This is done by first emptying the ball of air and then allowing it to refill itself from the larynx.

FIG. 120.



RIBEMONT-DESSAIGNES'S INSUFFLATOR.

The great advantage of Ribemont-Dessaignes's model over other forms is, that its laryngeal end coincides with the anatomical curves of the mouth and air-tubes, which it thus accurately fits without violence or injury.

The methods based upon turning to account the elasticity of the chest-walls, so as to produce a vacuum, and thus to suck in air, have one supreme advantage—they require no apparatus. The surgeon trusts to his hands alone. These methods deserve in an especial manner the title of *natural* or "*ready*" *methods*. As we have pointed out, an efficient cause of the first inspiration is the sudden release of the chest-walls from compression as the chest emerges from the vulva. The instant effect is the expansion of the chest and the creation of a vacuum, inducing an indraught of air. This series of phenomena is imitated in the methods of artificial respiration known as Marshall Hall's, Sylvester's, Howard's, Pacini's, and Bain's.

1. *Marshall Hall* called his the "*ready method*." It is effected in this way: Lay the child on its back, the head slightly raised; then roll the trunk over a little more than a quarter; turn on its side, until the chest looks a little downwards; then roll the trunk back to its original position; repeat this movement twelve to sixteen times a minute. The weight of the trunk upon the chest compresses it, and the elasticity of the chest opens it when the weight is taken off, and air is drawn in. Presently, if success is to attend, the stimulus of air in the lungs sets the heart going more fully, and spontaneous breathing is gradually or quickly established. Children have been restored by this and the other natural methods after half an hour, or even more.

Conditions essential alike to all the methods are, first, that the surrou air be warm and dry; secondly, that the child's legs and trunk and h protected from cold as much as possible by wrapping in warm, dry fl

2. *Sylvester's Method.*—Place the child on its back, the head slightly elevated; seize the hands or forearms, one in each of your hands, and extend them outwards so as to bring the child's hands above the level of the head; then bring the arms down again to its sides; repeat this manœuvre twelve to sixteen times a minute. The chest is thus pulled open by the attachments of the pectoral muscles, and it collapses again when the arms come down.

3. *Howard's Method.*—As we have seen Howard demonstrate it, the child is held on its back in the operator's left arm, the head hanging down a little; this attitude opens the larynx; then with the right hand the chest-walls and abdomen are alternately compressed and relaxed twelve to sixteen times in the minute.

4. *Pacini's Method.*—Place the child upon its back, and, standing behind its head, insert your hands in the axillæ on the dorsal aspect; then pull the shoulders towards you with an upward movement; then let them fall again. This is repeated twelve to sixteen times in the minute.

5. *Bain's method* is a modification of Sylvester's and Pacini's. The child lying on its back, place your fingers in its axillæ in their front aspect, with your thumbs over the outer ends of the clavicles, and draw the shoulders towards you. On relaxing your hold, the shoulders return to their former position.

6. Another method more commonly practised is to seize the child's arms, lift them up and from the sides so as to pull open the chest; then bringing them to the sides, compress the chest with your hands; then repeating the manœuvre, the natural elasticity of the chest is aided by the pulling-open movement by the arms.

We need only mention Schultze's method of swinging and tossing the child. It has not been shown to possess any advantage to compensate for the violence which characterizes it.

Appreciation of these Methods.—We have tried all these methods excepting Schultze's. Under each asphyxiated children have recovered. Under Marshall Hall's plan the rolling about of the child's head is awkward; but it has this advantage, insisted upon by Dr. Bowles, the most authoritative exponent of Marshall Hall's views, of permitting the escape of fluids from the lungs. Sylvester's and Bain's methods are more easily practised on the infant. Bain's and Sylvester's were admitted by a committee of the Medical and Chirurgical Society, on which C. J. B. Williams, Brown-Séquard, Dr. Burdon-Sanderson, and Mr. Savory served, to draw in more air than Hall's or Pacini's. We believe Howard's to be of equal efficacy. The experiments made by this committee were upon animals and dead adult men. But the results obtained by Dr. Champneys upon still-born infants led to similar conclusions ("Med.-Chir. Transactions," 1883). These laboratory experiments are not without value; but it would be unsafe to accept them as complete simulacra of like experiments upon infants *apparently* still-born. Apart from the great fact that in these last there exists in the vital spark a factor which is absent in the dead, there is the further fact that the chest-walls quickly lose after death a part of that resiliency which is a main active factor in the living. A drawback common to all methods, but in a less degree to Bain's, Howard's, and No. 6, is the protracted disturbance of the child. We have seen reason to conclude that in some cases the extensive movements did more harm than good; they constitute a kind of violence entailing shock; they may thus help to extinguish the latent scintillula, which gentle treatment might have fanned into life. Dr. Bowles points out that the plans, which are based upon the assumption that the chest-walls are expanded by pulling upon the arms, cannot be depended upon. The

pectoral muscles really exert but slight traction upon the chest. We conclude that Hall's and Howard's method, separately or combined, are best.

We have, however, become less sanguine as to the value of these methods. Where means of exciting reflex action failed, we have thought it best not to persevere too long with these artificial methods, but to wrap the infant in a warm flannel and get it nursed before the fire. In this way, by apparent inaction—deliberate, if not masterly—the flickering spark will sometimes gather strength, and respiration will be established. Not seldom have the attendants been surprised to hear a child cry which had been laid aside as hopelessly gone. But lookers-on are rarely competent to appreciate inaction. Inaction may be the best course, but it bears the outward likeness of neglect. Many a man has earned high credit for strenuous exertions which were really injurious.

In the cases of strangling by the cord round the child's neck or by the retracting vulva, it is useful, before tying the cord, to let a teaspoonful of blood escape from it. It is one of the most remarkable and gratifying illustrations of the phenomena of respiration and circulation to see how quickly the bloated, cyanosed aspect of the face vanishes, giving place to a healthy, roseate hue, when a good respiration is established. A vigorous cry accomplishes a great physiological purpose. It rapidly propels aërated blood throughout the entire system; all the capillaries are instantly permeated, and so the nervous centres receive the necessary stimulus.

Marshall Hall insisted forcibly upon "*secondary asphyxia*"—that is, after successful institution of respiration and apparent dispersion of the primary asphyxia, there might still persist an undue proportion of carbonic acid in the blood, which would gradually increase and ultimately culminate in the return of deep, perhaps fatal, asphyxia. Hence the necessity for continuous watching of the subjects of artificial respiration. The subsequent care is of the greatest importance. If the child have cried lustily, there is not much fear of relapse. But it is always advisable to wrap it carefully in warm, dry flannel, to nurse it before the fire that it may breathe warm dry air, and to use occasional frictions of the chest.

The *couveuse*.[1] In 1881, Tarnier introduced into the Maternité an apparatus designed to sustain the animal heat of delicate new-born infants. It consists of two compartments: a lower one, containing hot water, so constructed as to maintain a uniform temperature; and an upper, which contains the child's cradle. The hot-water compartment warms a current of air which warms the child's compartment. The standard temperature is about 34° C. Modifications of this apparatus, adapted by Budin, consist in a warning bell, which tells when the temperature is too high or too low, and indicates the need of regulation.

The value of this contrivance has been very marked in cyanosis simple, in cyanosis with œdema, athrepsia, syphilis, depression after severe labor, as in delivery by forceps, and prematurity. During their stay in the *couveuse* the children are fed with asses' milk by the spoon; all feeding-bottles or *biberons* are interdicted in the Maternité.

Observations prove that the pulse, temperature, and respiration are improved under the treatment.

Led by an analogous idea, Winckel tried the effect of prolonged baths, the child being immersed in the water. The observations are scarcely numerous enough to warrant clear conclusions; but we may appeal to all swimmers for testimony to the fact that the respiratory movements are performed with less freedom when the chest and abdomen are immersed in water.

[1] De la Couveuse pour Enfants. A. Auvard. 1883.

Atelectasis is that condition in which the lungs, either from imperf development or from want of penetration by air, retain partially their fo condition. The air-vesicles do not open; certain lobes—perhaps chiefly inferior—and the edges remain solid. This occurs especially in premat children, but sometimes it is observed in infants born at term in a stat athrepsy. It is also noticed in some cases in which respiration is not atten by that loud cry by which the new-born babe announces his arrival, and carries joy to the heart of the mother.

The breathing in atelectasis is characteristic. The inspirations are short, incomplete, and the effort, instead of expanding the lungs and arching the chest, seems to draw in the chest-walls concentrically. The result is that the ribs on either side of the sternum are flattened, or even curved inwards, as if seeking the spinal column.

We here interpolate a note on the remote effects of asphyxia.

Dr. Little, in a most suggestive memoir[1] "On the influence of abnormal parturition, difficult labors, premature birth, and asphyxia neonatorum on the mental and physical condition of the child, especially in relation to deformities," adduces clinical evidence in support of the proposition that spastic rigidity of the limbs, leading to deformities, may be caused by difficult labor.

Dr. Crichton Browne[2] is one of the few observers who have traced idiocy to difficult labor.

THE HEMORRHAGES OF THE NEW-BORN.—The chief seat of hemorrhage is the umbilicus.

Hemorrhages from the umbilicus are not frequent. The physiological diversion of the current from the hypogastric arteries offers a natural security. Still, it occasionally happens that, the ligatures being badly applied, or becoming loose from the shrinking of the connective tissue of the cord, hemorrhage breaks out after the child is dressed; and in this way the child may bleed to death before the cause is detected. In such a case, if the source be discovered in time, another ligature applied may be effective. But we have known serious bleeding take place from the umbilicus itself on the fall of the cord. In such a case we have secured the bleeding vessels by passing two needles at right angles to each other through the abdominal walls so as to get below the bleeding spot, and then twisting a fine silk ligature round the needles.

Ploucquet, Baudelocque, and others showed that by interrupting the respiration there arose a disposition to umbilical hemorrhage. The arterial tension being increased, and the physiological diversion of the circulation being disturbed, the current would be stronger towards the umbilical vessels.

Hemorrhage from the umbilicus or cord may be suspected if the child becomes suddenly or rapidly very pale and cold. In such circumstances not a moment should be lost in undressing the child for complete inspection.

Ribemont-Dessaignes ("Les Hémorrhagies chez le Nouveau-né," 1860) collects several cases of hemorrhage from the stomach and intestines; he also gives a table, from various sources, of hemorrhage from the vulva.

In many cases the hemorrhage is due to a grave dyscrasia. The quality of the blood is deeply impaired. In some cases, perhaps in most, the cause is hereditary. One of these conditions is hæmophilia. But it is not the most frequent. The influence of syphilis is ill-defined. Weber (of Kiel) thinks that the jaundice which so often attends the dyscrasic hemorrhages of the new-born is connected in syphilitic cases with a specific lesion of the hepatic parenchyma. But Parrot affirms that true icterus is very rare in

[1] Obst. Tr., 1862.

[2] "Psychical Diseases of Early Life," Journal of Mental Sc., 1860.

syphilitic children. Lancereaux relates a case in which liver and spleen were affected by syphilitic taint, and led to fatal omphalorrhagia. The association, however, of jaundice with hemorrhages has been frequently observed. The dyscrasic conditions which lead to hemorrhage from the umbilicus may also lead to hemorrhage from other parts, especially the intestines.

Athrepsia is a frequent morbid state in the new-born. The term was proposed by Parrot to express a condition resulting from any of the causes which impair nutrition; as physical causes, such as .malformation of the child's mouth or of the nurse's breast, insufficiency of milk; morbid causes, as erysipelas, œdema, congenital debility, sometimes syphilitic, peritonitis, eruptive fevers, and so on.

Athrepsia is not seldom attended by hemorrhage. An alteration of the blood appears to be the first condition. The hemorrhage may take place into any of the internal organs.

Traumatic Hemorrhages.—These may be internal, the result of injuries received during labor. Of course, an accidental wound, as from a pin, may be inflicted after birth. It has happened from the wound in vaccination; from that operation so often performed unnecessarily, cutting the frænum linguæ; and from circumcision. In such cases the bleeding may be stopped by actual cautery, or nitrate of silver.

CHAPTER XVIII.

THE FACTORS OF LABOR.

DEFINITIONS — DIAGNOSIS OF PRESENTATIONS AND POSITIONS — STRUCTURE — COMPONENT PARTS OF FŒTAL HEAD—DIAMETERS—PROPERTIES OF FŒTAL HEAD—MOULDING — FRACTURE — CHEST—TRUNK — BREECH—PLASTIC PHENOMENA—CAPUT SUCCEDANEUM—CEPHALHÆMATOMA—THE MECHANISM OF LABOR; HEAD; FACE; OBLIQUE OR TRANSVERSE—SPONTANEOUS VERSION—SPONTANEOUS EXPULSION—TWINS—TRIPLETS.

In describing the mechanism of labor the following terms are used: *Presentation*, *Position*, *Vertex*. It is necessary to attach a definite meaning to these terms.

1. *The obstetrical definition of Presentation* is that part of the child or ovum which presents at the pelvic brim and os uteri. Thus when the head engages first in the brim or cervix uteri, it is said that there is a "head presentation."

Presentations are Natural or Preternatural.

According to Naegele, *those presentations are natural* in which the long axis of the child nearly coincides with the axis of the pelvis. Under this definition will fall the presentations of the head and breech or pelvic extremity.

Those presentations are preternatural in which the long axis of the child does not nearly coincide with the axis of the pelvis. Under this head fall trunk and shoulder presentations. These are also called transverse or oblique presentations, and vulgarly, cross-births.

A characteristic of the natural or head and breech presentations is that labor can be completed in them by the natural powers. On the other hand, in the preternatural or transverse presentations, the presentation must almost always be changed by nature or art before labor can be carried out.

2. The *position* means the relation of the presenting part of the child to the diameters of the pelvis. Thus when the head presents with the occiput directed to the forepart of the pelvis, there is said to be an occipito-anterior "position."

3. The *vertex* of the head is the summit—*i. e.*, the space between the fontanelles and the parietal protuberances.

The Diagnosis of the Presentations and Positions.

One of the first clinical problems to be solved is: *What is the presentation?* And secondary upon that is: *What is the position?*

The *head*, if presenting by the vertex, is recognized by the firm expanse of its bones, by its sutures and fontanelles, by the plasticity or overlapping capacity of the parietal bones along the sagittal suture.

The *diagnosis* of the several positions will be described when tracing the mechanism of labor in each position.

The Fœtus in its Obstetric Relations.

We will first describe the head. The general form of the head must be studied in the first place as it exists before labor—that is, before it has undergone compression and moulding in the parturient canal.

The *general form of the head before labor* approaches the spherical; but, taking in the face, there is a long diameter measured from the most prominent point of the occiput to the tip of the chin. With this it forms an ovoid.

The Structure and Component Parts of the Fœtal Head.

The head is that part of the fœtus which takes the first place in obstetric interest. It is the largest and the most solid part. It is composed of two distinct parts—the cranium and the face. The *face* is made up of fourteen bones, two of which, the vomer and lower jaw, are single, and twelve in pairs—namely, the upper maxillary, the palatine, the nasal, the ossa unguis, the malars, and the inferior turbinated bones.

The *cranium* is made up of eight bones, four single and two pairs—the frontal, the occipital, the ethmoid, the sphenoid, the two parietals, and the two temporals. The frontal at first is composed of two symmetrical halves; the sides of the cranium are made up of the parietals and the squamous portions of the temporals; the hinder part is made up of the shell of the occipital. The basis of the skull is composed of the sphenoid, the ethmoid, the petrous portion of the temporals, and the basilar portion of the occipital.

At the base the constituent bones are, if not consolidated, so far united that little mobility remains. But at the vault of the cranium the conditions are different. The bones here do not quite meet, but they are united by flexible membranes. The lines of union thus formed are called *sutures* and *fontanelles*. This disposition allows the bones to ride over each other under compression. There is also a cartilaginous hinge or groove between the shell of the occiput and its basilar portion which admits of movement.

Fig. 121.

To show Sutures on Summit. Sagittal, Coronal, Lambdoidal, and Fontanelles.

The *sutures* are (1) the *sagittal* or *antero-posterior*, running from the root of the nose to the upper angle of the occipital. Anteriorly the membrane separates the two halves of the frontal bone; at the top and posteriorly it separates the two parietals. It is crossed by (2) the *fronto-parietal*, *transverse*, or *coronal* suture. This is situated at the union of the parietal and frontal bones. It crosses the sagittal suture, and ends on either side below at the squamous portions of the temporal. (3) The *occipito-parietal* or *lambdoidal* suture, so-called from its resemblance to the Greek Λ. It is formed by the union of the posterior and lower border of the parietals with the squamous portions of the temporals, and by the union of the occipital with the posterior border of the parietals. The point of the suture corresponds with the upper angle of the occipital. It might be regarded as the bifurcation of the sagittal suture.

The *fontanelles* are two. The name is given to the membranous spaces seated at the meeting of the sutures.

1. The *anterior*, the *large* or *bregmatic fontanelle*, or simply *bregma*, is situated at the crossing of the sagittal and coronal sutures, which cross almost at right angles. It is lozenge-shaped, presenting four borders and four angles. The two posterior borders, shorter than the anterior, are formed by the parietals. The two anterior borders, longer, are formed by the divergence of the two halves of the frontal bone. In practice it is not unusual to find

that the typical lozenge-shape as felt during labor gives the sensation of being triangular.

2. The *posterior fontanelle* is situated at the meeting of the lambdoidal and sagittal sutures. Strictly speaking, the bones at this point often meet so closely that a membranous space or true fontanelle can hardly be said to exist. When found it is small and triangular.

Two *lateral fontanelles*, or Gasser's fontanelles are described. They are situated at the point where the lambdoidal suture runs into the temporal suture. They can hardly be felt during labor, and are of minor obstetric interest.

Fig. 122.

To show head and face in profile.

Occasionally ossific centres detached from the parietals or occipital form separate bones. These are called ossa triquetra.

The *occipital hinge* or *groove*. Budin describes, under the title "*charnière occipitale*," a kind of fibrous and cartilaginous hinge which allows these two bony elements of the occipital, the basilar and squamous, to execute movements of flexion and extension upon each other. This arrangement is of importance in the moulding of the head.

The articulation of the head with the vertebral column is of extreme importance, especially in relation to the operation of turning. The articulation of the occipital bone with the atlas is very close, admitting of but slight movements. The free movements of flexion and extension of the head are due to the combined action of the cervical vertebræ. The junction of the cranium with the spinal column is nearer to the occiput than to the forehead. Thus the anterior arm of the lever formed by the head is the longer. Hence, supposing resistance to be equally distributed over the cranial vault during labor, driving force transmitted along the spinal column will cause the occipital arm of the lever to descend. Hence the movement of flexion. The general anterior curvature of the fœtal body forwards also promotes flexion. The *rotation-movements* by which the head is turned to the right or left shoulder take place in the atloido-axial articulation. This permits a rotation-movement either way to the extent of a quarter of a circle. Can this range be exceeded without tearing the ligaments and the spinal cord? Tarnier thinks that the face may be made to look directly backwards without injury. This may be so in exceptional cases. But we are sure we have seen fatal dislocation from less extensive rotation.

Fig. 123.

Base of skull to show the occipital joint. (Budin.)

A. Basilar-process of occipital bone. O. Scale of occipital. CC. Cartilaginous lamella, outer. E Fibrous lamella. F. Foramen magnum. D. Charniere occipitale.

The Diameters and Circumferences of the Head.

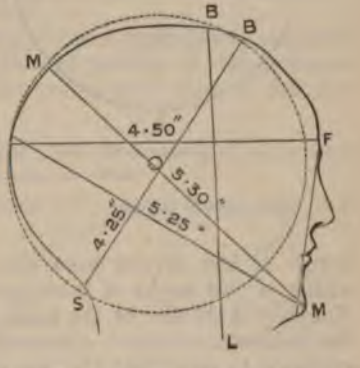
The size and shape of the head constitute most important factors in the mechanism of labor. It may be stated as a general law, that the head bears an approximate relation in size and form to the size and shape of the pelvic canal. This is proved by the fact that the head is driven through the pelvis with some difficulty, showing close correspondence; and without injury to the mother or child, showing mutual accommodation.

The text-books almost universally give the dimensions of the fœtal head after birth, that is, after the head has undergone a process of moulding during labor. Dimensions so taken, no matter from what number of observations the average is struck, are necessarily fallacious. They represent not what is postulated—the state of the head at the beginning of labor, that is the primary dimensions—but the resulting or secondary states created during labor. Such measurements are seriously misleading. We do not, therefore, think it desirable to reproduce tabular statements of the measurements commonly given.

The measurements which follow are not, it is true, based upon an imposing array of numbers, but upon well-selected, fairly typical examples. We shall start from the original or prepartum state, and then trace and compare post-partum or secondary states.

If abstraction be made of the lower part of the fœtal face, especially of the chin, the general shape of the head is found to be more nearly spherical than it is usually represented (see Fig. 124). The diameters of the head are longitudinal, transverse, and vertical. The *longitudinal diameters are four*, namely: 1. The *maximum*, M M (Fig. 124), measured from the tip of the chin to the most distant point of the skull, This is usually on the sagittal suture, between the point of the occiput and the posterior fontanelle. This point is not fixed. 2. The *occipito-mental diameter* (O M, Fig. 124) measured from the occiput to the tip of the chin. This is often described as the longest diameter, but in fact a longer one, that described as the maximum diameter, can almost always be found. 3. The *occipito-frontal diameter*, O F, extends from the point of the occiput to the root of the nose. 4. The *suboccipito-bregmatic diameter*, S B, from the point of meeting of the occipital bone and nucha to the middle of the greater fontanelle.

FIG. 124.



SHOWING THE LONGITUDINAL DIAMETERS. THE DOTTED CIRCLE SHOWS THE APPROACH TO SPHERICITY OF THE HEAD.

M M. Maximum diameter. O M. Occipito-mental diameter. O F. Occipito-frontal diameter. S B. Suboccipito-bregmatic diameter. L B. Laryngo-bregmatic diameter.

The *transverse diameters are three:* 1. The *biparietal diameter* (P P, Fig. 125), from one parietal protruberance to the other. The *bitemporal diameter*, T T, from the origin of the fronto-parietal suture of one side to the corresponding point on the opposite side. 3. The *bimastoid diameter* (M M, Figs. 125, 126) taken between the two mastoid apophyses.

The *vertical diameters are two:* 1. The *fronto-mental diameter* (F M, Fig. 124), taken from the highest point of the frontal bone to the tip of the

chin. 2. The *cervico-bregmatic* or *laryngo-bregmatic diameter* (L B, Fig. 124), is taken from the middle of the anterior fontanelle to the upper and anterior part of the neck near the larynx.

Circumferences.—In connection with the diameters, we must note the circumferences. The chief are—1, that running around the head at the maximum diameter, the *greatest circumference*, and 2, that running round at the suboccipito-bregmatic diameter, the *small circumference;* 3, that taken in the occipito-frontal diameter, the *equatorial circumference* (see Fig. 124).

The dimensions of the head are greater in boys than in girls. J. Y. Simpson showed that the larger number of difficult labors occurred with boys, and it has been ascertained that a larger proportion of boys are still-

FIG. 125.

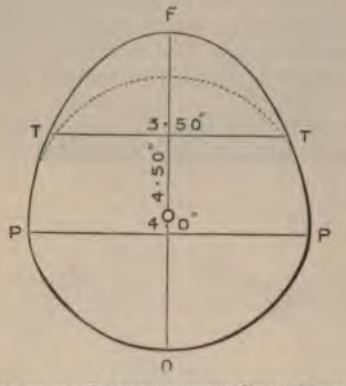
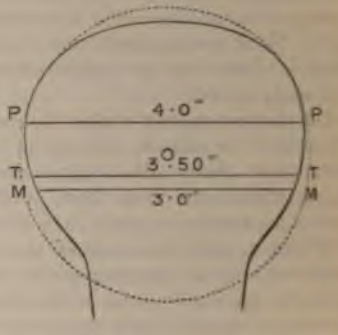


FIG. 126.



OUTLINES AND DIAMETERS OF THE FŒTAL HEAD O, AND THE TRANSVERSE DIAMETERS. THE DOTTED CIRCLE SHOWS THE APPROACH TO SPHERICITY OF THE HEAD.

O F. Occipito-mental diameter. T T. Bitemporal diameter. P P. Biparietal diameter. M M. Bimastoid.

born. It has further been shown that a larger proportion of boys perish within a few weeks of labor, owing to the injury sustained during labor. Not only is the size of the head greater in boys, but in many cases at least, the ossification is more advanced, therefore the plasticity is less. There is evidence to show that the size of the fœtal head has increased under the process of civilization. A similar contrast is seen between the heads of the savage and the civilized races. Nothing within the range of human anatomy stands in stronger contrast than the cerebral size and development of the New Hollander or the Bushman and the Caucasian races. Education amongst different classes of the same race also affects the size of the brain and cranium. Hatters state that the size of the head is greater in the same classes in town than in agricultural districts, in the educated than the uneducated. Simpson believed that the comparative difficulty of parturition with male and female children extends to the fœtus of civilized and uncivilized races, and he refers the increased suffering of civilized women in childbirth to the size of the fœtal head. We are not aware of any precise data to show that the capacity of the pelvis has been altered under the influences of civilization.

The Dimensions and Weight of the Child.

Certain properties attached to these diameters must be noted. The longest, or biparietal, is not a constant length. It undergoes shortening under bilateral pressure. In this way it may be reduced by half an inch or more; or it may be reduced by the bone bending or breaking in.

The bitemporal or binaural diameter traverses the sphenoid bone, and is unyielding. It is therefore a fixed quantity; and in labor we must count upon this quality. It will be seen that the biparietal diameter, when at its extreme shortening, still exceeds the bitemporal.

The bifrontal diameter is shorter than the biparietal. In labor, with projecting promontory, this diameter sometimes gets engaged in the conjugate diameter of the pelvic brim, and thus the greater difficulty that would be encountered if the biparietal got engaged in this position is evaded.

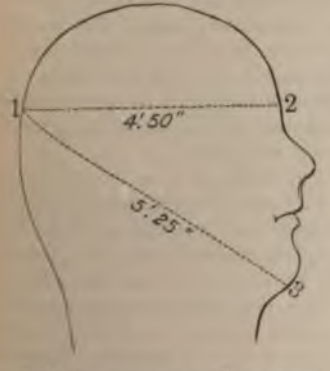
The vertical diameters are subject to shortening. The cervico-bregmatic is necessarily shortened under circular compression of the skull. Its shortening is compensated by lengthening of the longitudinal diameters.

FIG. 127.

THE BASE OF THE FŒTAL SKULL.
M M. Bimastoid diameter.

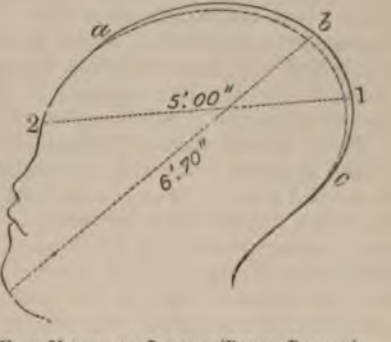
The fronto-mental is more fixed. The frontal portion of the diameter, however, is susceptible of shortening, and the component parts of the face

FIG. 128.



THE LONGITUDINAL OF THE FŒTAL SKULL.
1 to 2. Occipito-frontal. 1 to 3. Occipito-mental.

FIG. 129.



HEAD MOULDED IN LABOR. (ROBERT BARNES.)
a. Frontal bone. b. Parietal bone. c. Occipital bone.

The vertical diameters yield a little. This diameter assumes importance in delivery after craniotomy.

Both the longitudinal diameters are subject to change in labor. In ordinary head-labors they are elongated; but, under certain conditions, they may be shortened.

TABLE OF DIAMETERS OF STANDARD FŒTAL HEAD, BEFORE MOULDING BY LABOR.

	Symbol.	Length inches.
Longitudinal.		
1. Maximum	M.M.	5.25
2. Occipito-mental	O.M.	5.00
3. Occipito-frontal	O.F.	4.60
4. Sub-occipito-bregmatic	S.B.	4.25
Transverse.		
1. Biparietal	P.P.	4.00
2. Bitemporal	T.T.	3.50
3. Bimastoid	M.Mas.	3.0 to 3.25
Vertical.		
1. Fronto-mental	F.M.	2.15
2. Laryngo-bregmatic	L.B.	3.75

We have seen that the head is so nearly adjusted in size to the pelvic capacity that it is propelled with difficulty. If both pelvis and head were absolutely rigid, the head would hardly ever pass through by natural forces. The head, therefore, adapts itself by moulding. This means that it changes its shape. The changes undergone are of great interest.

The leading points are stated in a memoir by Robert Barnes.[1] The method of observation adopted was to trace the outlines of the head after birth, and to correct these tracings by measurements taken by the "*compas d'épaisseur.*" A better way is to take casts; but the results obtained by the method pursued are fairly trustworthy when checked by repeated observations.

THE MOULDING IN OCCIPITO-ANTERIOR POSITIONS.—The occipital elongation, or the "sugar-loaf head," is the most familiar deformation. But the attending lateral and asymmetrical moulding which the head undergoes has been little, if at all, noticed. The tracings submitted make this manifest. They prove that under all modes of birth, if the head is a little delayed in transit through the brim, it will be unequally moulded on the two sides. The side which is squeezed against the sacral promontory will be somewhat flattened, whilst the side opposed to the symphysis pubis, suffering generally less compression, preserves more of its normal rotundity.

There is still another deformation, one very difficult to represent by diagrams, sections, or even by photographs. The pelvic canal may be likened to a rifled gun; it is so constructed as to render the propulsion of the fœtal head in a direct course impossible. The head is made to revolve on its own axis during propulsion much as a conical ball revolves on its own axis during its passage through a rifled gun. The difference consists mainly in the circumstance that in the case of the head, this is, at starting, nearly globular, and acquires its conicity in transit. Now this cone, being the result of the moulding of a plastic body pursuing a helicine course, is somewhat twisted or screwed; and the lowermost part or presenting apex is not found in the median line of the head but on one side of the sagittal suture. The deformation is, therefore, threefold: 1. Elongation or conification; 2. Asymmetrical flattening of one side; 3. Twisting or screwing of the conified portion on its axis.

After birth, by virtue of resiliency of the components of the cranium and the expansion of the contents, there is a marked tendency to recovery

[1] On the Varieties of Form imparted to the Fœtal Head by the Varic Birth. Obstet. Trans., 1866. Budin has also made valuable observatio

he prepartum shape—that is, a force of restitution. The measurements should therefore be taken within an hour or so after birth. Tarnier points out that if we want to get correct data for estimating the original or prepartum shape of the head, the measurements should be taken two or three days after labor, as by that time the original shape will have been nearly recovered. But admitting to a great extent the truth of this proposition, we believe the original shape of the head is rarely quite regained. Something of the moulding to which it was subjected during labor often remains for years, even through life.

A skilled observer surveying the heads of persons in an assembly, may by help of this key read off with tolerable precision the modes in which a large proportion came into the world. On such a survey it will be seen that the sugar-loaf predominates. It is true that the head retains for some time after birth a certain degree of plasticity, and this property is turned to mistaken account by some people—not otherwise barbarians—in imparting special forms to the head according to the dictates of custom or their ideal of beauty. We do not know that this practice is ever applied to the restoration of the true spherical types. In some cases of excessive distortion this might be justified.[1]

Comparing the skull, with its flexible bones, membranes, and scalp, filled with its pulpy brain, with a bag filled with water, we may see that, like this, *the skull is incompressible.* If it be pressed in at one place, it must bulge out in another. The shape may change, but the capacity or volume does not. To pass through a ring or cylinder like the parturient canal, the spherical skull, if larger in its equator than is the calibre of the canal, must then be drawn out or elongated so that it shall enter and traverse the canal with one pole of the resulting ovoid corresponding with the axis of the canal, unless indeed the canal itself be distended enough to stretch as the skull moves on. Now stretching does take place as far as the soft structures of the canal are concerned; but outside and supporting the soft canal is the bony pelvis which yields but slightly, if at all. Thus the stretching is limited (see p. 131, "On the Properties of the Pelvis").

There are then two resisting factors in the problem of propulsion. The passage or parturient canal, and the passenger or fœtus seek to adapt themselves to each other, the one by moulding, the other by stretching. When the sought-for adjustment, by the failure of one or other factor cannot be attained the labor comes to a stand, unless the fœtus be reduced in bulk or the canal be enlarged by operation; or, these resources failing, unless the difficulty be evaded by the Cæsarean section.

The moulding of the head is chiefly accomplished by the diminution of its mid-circumference or equator—a zone traced transversely across the sagittal suture, passing over the protuberances of the parietal bones, descending over the ears, and completed at the base of the skull in the direction of the sub-occipital bregmatic diameter (see Fig. 124, S B). This circumference admits of different degrees of diminution in different subjects. The part of the circumference made up of the sphenoid and the basilar part of the occipital bone is very nearly incompressible. The yielding is due to the imperfect ossification of the parietal, frontal, and occipital bones, a little to the imperfect ossification of the squamous portion of the temporal bones; greatly to the mobility of these bones, and to the infolding of the occipital upon the "hinge" described by Budin (see Fig. 123). Thus the parietals move inwards on their lower attachments to the temporals and occipital, as on hinges; and

[1] For much interesting part fanciful shapes rk by Professor to the practices pursued by various peoples to the reader is referred to an admirable little

their upper margins approach and even override along the sagittal suture. This ring-like diminution in the equator entails bulging backwards or elongation of the occiput.

The next point of resistance is at *the shoulders*. The average diameter between the tips of the shoulders, the *bisacromial*, is between five and six inches. It is capable of considerable shortening by the curving forwards of the shoulders. Where an average head has passed, the passages have been so stretched that the resistance to the shoulders is not often material. Still it has to be considered. There is a second mode of adaptation by which the extreme bisacromial diameter is practically reduced. As the shoulders descend, one is by a process of leverage brought lower than the other; that is, instead of descending exactly synclitically or in the same planes, the shoulders may come obliquely. This process is successfully imitated in practice when the shoulders are delayed, by gently hooking one down by the finger, or in marked disproportion, by help of a blunt hook slipped into the axilla.

The *chest* is also capable of elongation; but it rarely opposes much difficulty where the head and shoulders have opened the way.

The *abdomen* also adapts itself without much difficulty.

Lastly, we come to the *breech*. The greatest diameter is the bitrochanteric. Owing to the imperfect ossification of the fœtal pelvis, the breech enjoys some compressibility. The breech alone, as when the legs precede, rarely gives rise to delay. But when to the breech are added the flexed thighs, the combined volume may create as much difficulty as the head. The compressibility of the mass is limited. F. Weber[1] found laceration of dura mater and effusion of blood between it and the bones, rupture of the longitudinal and transverse tissues of the brain, and considerable hemorrhage on surface and base of brain, sometimes sufficient to envelop cerebellum and medulla oblongata in cases in which mechanical injuries to bones had occurred, whether or no instruments had been used to complete delivery.

Another property of the fœtal skull is *fragility*. The frontal, parietal, temporal, and occipital bones may be fractured. This happens very rarely indeed under spontaneous labor; but it is very important from a medico-legal point of view to recognize this possibility; and from a clinical point of view to recognize the conditions under which it may occur.

Dr. Cory experimented on fifteen children in the same way as Chaussier, and with similar results. The dead children were dropped head-first upon a paved floor, a distance of eighteen inches. Out of the fifteen children experimented upon, eleven had one or both parietal bones fractured. These results are valuable as showing the very strong probability of a child having its head fractured should it be born suddenly and fall to the ground while the mother is standing. Deep indentation of the parietal at the point of contact with the promontory has been observed in spontaneous labor, head-first and head-last.

Fracture of the cranial bones is of course more frequent in labors assisted by operations, more especially when the pelvis is deformed. 1. The parietal bone, which has to round the projecting promontory of the sacrum, may be indented, even fractured. This is chiefly seen in head-last labors especially if the conjugate diameter of the pelvis be contracted. 2. It may occur also in head-first labors when the forceps is applied above the brim, if the contraction of the brim be marked.

The bones of the cranial vault are necessarily broken in craniotomy and cephalotripsy. The bones of the base of the skull may be crushed down under the cephalotribe. But this, Braxton Hicks has shown, is not necessarily the case.

[1] Beiträge zur pathologischen Anatomie der Neugebornen, 1851–4.

The degree of compressibility of the fœtal head compatible with life. This is ery difficult, if not impossible, to estimate.

Resiliency or elasticity is a property possessed in a high degree by the living œtus, and almost lost in the dead fœtus. *Resiliency is marked in the head.* It is the compensating property to compressibility. After compression, the head, we have seen, to a certain extent recovers its shape. This is due partly to the upspringing of the parietals, frontals, and temporals, and occipital on their lower attachments, and partly to the resumption of their original shape, just as a piece of cup-shaped thin elastic metal will resume its cup-shape after being flattened by pressure. There is another factor, due entirely to vital action. The pressure taken off the skull, the circulation is restored to the cerebral vessels, and the resulting increase of matter opens out the skull by eccentric pressure, thus aiding the resiliency.

Resiliency in the Spinal Column.—This property is an important factor in labor. The driving force exerted by the shortening of the uterus tells first upon the breech at the fundus. It is propagated through the elastic rod formed by the spinal column. The head is thus forced down upon the cervix uteri. This structure offering resistance, the body of the fœtus bends a little under the pressure encountered at its two ends. But it is constantly tending to straighten itself, and thus the containing body, the uterus, gradually yields at its weakest point—the cervix—which is made to open. It is partly upon the preservation of this property that success in version, spontaneous or operative, depends.

The *chest* also is endowed with resiliency. It may undergo considerable elongation under compression, and yet, as soon as the pressure is taken off, its walls expand again. This has not a very obvious relation to the mechanism of labor; but it is all-important as a factor in respiration.

During the passage of the chest through the partrurient canal it is compressed; but the moment it is born, the chest-walls, expanding by virtue of their elasticity, suck in air. This, Robert Barnes insists, is a main factor in inducing the first respiration.

The compressibility of the abdomen is proved by the occasional squeezing out of meconium during the passage of the trunk through the pelvis. This squeezing must be distinguished from the evacuation which sometimes takes place as a vital act under attempted inspiration.

Ductility is another property. It is a form of plasticity. The spinal column is not so rigidly set but that it is susceptible to a moderate degree of drawing out under traction. This property hardly comes into application in head-labors; but in head-last labors, when it is necessary to put on *vis à fronte*, traction on the legs entails dragging on the spine. It is difficult to estimate even approximately the force that can be so used without lacerating the vertebral ligaments. So-called laboratory experiments on the dead fœtus, which consist in putting on a succession of weights to determine the resisting power, are of no value for clinical application. The conditions are essentially different from those which obtain in the living subject. It is certain, in the first place, that a live fœtus, or one dying during the labor, will bear a greater strain. In the second place, it is all but impossible to measure the resistance offered by the pelvis and other forces. In practice we are satisfied that, by delicate management, we have occasionally brought out a living child by help of an amount of force that would have torn a dead child out of the body asunder. The opposite conditions of the two cases negative comparison.

It is important to notice *the weakest point of the spinal colun* strain it gives way at the cervico-occipital union. This may because the strain is usually concentrated upon this point.

caught in the pelvic brim when traction is put on below, the occipito-vical joint is the centre upon which the force tells.

The Plastic Phenomena of Labor.

Deformations of the Fœtus produced during Labor.

Although the soft parts of the genital canal are dilatable, they offer resistance enough during dilatation to impart certain changes of shape to the fœtus. The soft parts indeed, alone almost, produce the *serosanguineous swellings* which are observed on the surface of the child's body after birth. The same conditions which produce the serosanguineous swellings are also adequate to produce certain *changes in the form of the cranial bones.* Certainly they occur in cases where the pelvis is well-formed, and where the child is born alive and capable of thriving.

When describing the process of labor under the several presentations and positions, the special characters of the serosanguineous tumors and of the cranial deformations formed will be referred to.

We may in this place point out some general features and the ruling etiological conditions.

The *cranial deformations* are produced by the compression which the head undergoes during its propulsion through the pelvis. Before entering the pelvis the head is nearly spherical. In this form its equator may be too large to enter or to traverse. A process of adaptation therefore takes place, by which its equatorial diameters are reduced, and other dimensions are increased. *It is accommodation by moulding.*

The most typical of *the serosanguineous swellings* is that which forms on the head, and which is called the *caput succedaneum*, as if a secondary head were developed. But, whatever the part that presents, analogous swellings are formed unless the labor be rapid and easy.

The most natural explanation of the etiology of these serosanguineous swellings is that they are the effect of annular constriction. Thus, the primary swelling is due to the os uteri encircling the presenting part of the head as a tight ring; the arteries of the scalp propel blood into the part of the scalp which protrudes through the constricting ring, whilst the compressed veins cannot return it; hence extravasation of serum and sometimes blood. The secondary swelling is due to similar constriction of the vulva. It is thus seen that *the formation of the caput succedaneum*, and of the equivalent swellings on the face, breech, or shoulder, *is a vital phenomenon* depending upon the circulation.

Cephalhæmatoma.—In the ordinary cases the effusion is chiefly or entirely serous; in others there is blood as well as serum—that is, ecchymosis. The seat of these infiltrations is the subcutaneous connective tissue. These are the ordinary forms of the caput succedaneum. They entail no danger to the child; the effused fluids are rapidly absorbed, so that after two or three days barely a trace of even large swellings is perceived. But in a distinct class of cases this serosanguineous intracellular infiltration is complicated with blood-extravasation between the periosteum and the bone. The periosteum is raised by a layer or mass of dark blood, the bone from which the membrane is separated is stained red, the capillaries of the diploë are gorged with blood. The dura mater of the corresponding inner surface is also detached by a thin layer of dark fluid blood. The sinuses of the dura mater are filled with black blood. The pia mater is reddish; its capillaries are gorged with blood; the choroidal plexuses are deeper colored than usual.

These cases are of graver import. The child not uncommonly perishes, either from the immediate effects of the effusion or from the attendant compression of the brain, and other injuries.

In these latter cases some greater force than that exerted by the soft parturient canal has been in operation. Pelvic distortion or contraction, or undue size of the head, or the use of instruments have commonly concurred.

Several important lessons, clinical and medico-legal, may be drawn from the study of these serosanguineous tumors and cranial deformations.

First, we have seen that the formation of the serosanguineous swellings is a vital act. Therefore the child, even if not born alive, was living during the propulsive stage of labor.

Secondly, by careful examination during labor, we may watch and observe the formation of the scalp-tumor, and gather from this the conclusion that the child is living.

Thirdly, we may after birth determine very closely the part of the child which presented and the position of the presenting part during labor.

Fourthly, we learn from the cranial deformations to estimate the *plasticity of the fœtal head*. The simple caput succedaneum varies in site according to the position of the head.

A. The Caput Succedaneum in Occipito-anterior Positions.—In these positions, the head advancing, the occiput is on a lower level than the forehead, and the parietal bone, which is anterior or nearest to the symphysis, is lower—that is, nearer the centre of the os uteri—than the posterior parietal bone. The consequence is that the swelling forms chiefly on the anterior parietal, and more especially on the upper and posterior angle near the union of the sagittal with the lambdoidal suture. Thus, in the first or left occipito-anterior position the swelling is formed over the upper and posterior angle of the right parietal, encroaching on the lesser fontanelle and occiput. In the second or left occipito-anterior position, the swelling is formed over the left side of the cranium.

B. The Caput Succedaneum in Occipito-posterior Positions.—In these positions the swelling occupies the upper and anterior angle of the parietal, which corresponds to the pubic arch, encroaching a little upon the larger fontanelle and even upon the frontal bone.

By observing the seat of the caput succedaneum we may form a retrospective diagnosis of the position. If the head traverses the vagina and vulva rapidly, the primary swelling described may be in its simple state; but if the head has been delayed long after passing the os externum after its rotation, a secondary swelling is formed nearly in the median line. The first swelling subsiding somewhat may attract less attention than the secondary one; but there will always remain some degree of laterality of the swelling, which will indicate the position the head occupied at the pelvic brim.

C. The Serosanguineous Swelling in Face Presentations.—When the face presents, the equivalent of the caput succedaneum forms on the face. In mento-anterior positions the swelling will be on the inferior part of the malar region and the side of the mouth, and on the upper part of the malar region, and even on the eye in mento-posterior positions. The greatest swelling will be seen where the subcutaneous connective tissue is loosest; hence the eyelids are so swollen that they cannot open. The expression given is most ghastly, suggesting severe violence. The upper lip and malar region also are liable to great effusion. The swelling sometimes extends to the submucous tissue, so that the child may be unable to suck for some days. The color of the swollen parts is deep-blue or black. The swelling, formidable as it looks at birth, goes down with astonishing rapidity, so that at the end of three days there is rarely much to be seen.

D. The Serosanguineous Swelling in Breech Presentatio
When the breech presents, the tumor is formed more especially on one
tock, and commonly invades the genital organs. In the right sacro-
positions the swelling is on the right buttock; on the left buttock in
sacro-iliac positions. The female genitals show the swelling less tha
male genitals. The swelling of the scrotum and penis is at times exte
and the size and deep-blue or black color may suggest to the unskilled
conclusion that they are the result of severe violence inflicted by the
stetrist. This swelling also rapidly subsides, leaving the child uninju
When the knees or the feet present, like swellings are formed, but they
less marked.

E. When the shoulder presents, the swelling is formed upon
prominent part of the shoulder, if this part occupied the centre of the pel
but it extends backwards or forwards as the presentation inclines to one
the other direction. When the arm or the forearm comes down, the sw
ing forms upon these parts. In cases in which the shoulder presents at fi
and when the arm comes down later, the arm may become enormou
swollen, and dark-colored, if long subject to compression at the shoulder.

The Mechanism of Labor.

Being now in possession of the requisite knowledge of the factors of la
namely, the pelvis (see chap. vi.), the fœtus, and the driving force, or
Alexander Simpson alliteratively describes them, the passages, the pas
ger, and the power, we are enabled to trace the mechanism of labor.

It is usual to begin the description of the mechanism of labor with
adjustment of the presenting part of the fœtus upon the brim of the pel
and then to trace the progress of the fœtus through the pelvic canal
outlet. In this way a very important part of the process is overlooke
inadequately noticed. The pelvic course of the child is but one p
before this part is run, the child has to go through a suprapelvic cou
This suprapelvic course determines the lower or pelvic course, and in m
cases it governs the position of the presenting head or breech.

It is true that in many cases, especially in primiparæ, the fœtal head
engaged in the pelvic cavity, partly at least, before the advent of ac
labor. But even in these cases, we must admit a preliminary stage,
indeed marked by active uterine contraction, during which the presen
part, especially if this be the head, is made to traverse the suprapelvic
of the parturient curve, carrying down the inferior segment of the ut
before it. This preliminary stage is effected often some days or a fortni
before active labor, marked by expansion of the cervix uteri, sets in. I
not the less a part of labor.

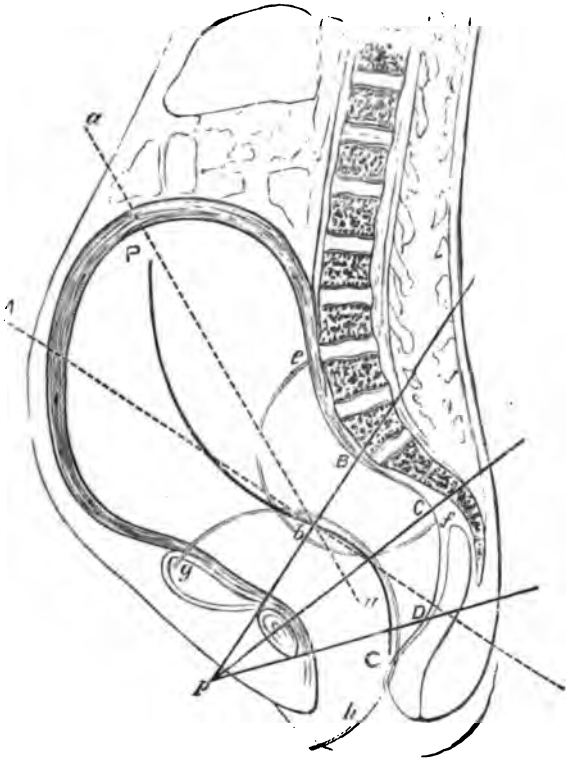
Reference to the diagram (Fig. 130), will show that the child m
follow a track governed by the shape of the lumbar spine, the sacral h
low, and the outlet of the pelvis. This track has for its elementary c
stituents two principal curves: 1. The lumbo-sacral curve, drawn from
sacral promontory as a centre, with a radius intersecting the middle of
plane of the brim. This (Fig. 130, *e f*) is Barnes's curve. The secon
is that familiarly known as Carus's curve. This is drawn from the sy

[1] This subject is discussed in a memoir "On the Mechanism of Labor, especia
with reference to Naegele's obliquity, and the influence of the lumbo-sacral curve,
the Obstetrical Transactions, 1884, by Robert Barnes. In the same volume is a vale
ble contribution to the same problem by Dr. Galabin.

physis pubis as a centre with a radius following nearly the axis of the pelvic cavity (Fig. 130, *g h*). These two curves cut each other about mid-pelvis. This point of intersection may be taken to indicate the merging of Barnes's curve into Carus's curve, and thus the changing of the course of the advancing head from the axis of the brim to the axis of the outlet.

These two curves have for their resultant the true "parturient curve," a serpentine or double curve, which, in parenthesis, may be likened to "Hogarth's line of beauty" (see Fig 130, P C). The first or upper part of

FIG. 130.



CONSTRUCTED ON CHIARA'S FROZEN SECTION TO SHOW THE AXES AND CURVES OF THE UTERUS AND PELVIS. (ROBERT BARNES.)

A D. Axis of brim of pelvis. *a u.* Axis of uterus. *A ba.* Angle of divergence of uterine axis from pelvic axis *p B.* Plane of brim. *p C.* Plane of cavity. *p D.* Plane of outlet. *e f.* Barnes's curve. *g h.* Carus's curve. *P C.* Parturient curve.

this curve has been generally neglected. The lumbo-sacral curve itself may be studied in two parts, namely, the part above the pelvis, or most prominent point of the promontory, and the part below this point. The upper part must be drawn with a larger radius than the lower. The basis of it is the lumbar spine terminating at the promontory. The lumbar spine forms an inclined plane with a moderate curve, upon which the uterus and the contained fœtus are moulded. The uterus forms a concavity in its posterior wall to fit the convexity of the lumbar spine; and the contained fœtus fitting itself to the containing uterus also forms a corresponding concavity in that

aspect which looks to the mother's spine. Indeed, we contend that it is this necessary accommodation of the uterus and fœtus to the mother's spine which determines the ordinary dorso-anterior attitude of the fœtus. The mechanism is obvious. The lumbar spine forms an unyielding, projecting, rounded surface; the child's spine is also the most unyielding part of its body; it forms a prominent curve in length and in width. Now, when two such curves come into contact, the movable body must be deflected—that is, the child's spine is turned aside, and the continuous pressure of the abdominal walls upon the uterus, aided, perhaps, by the movements of the uterus itself, help to bring the child's back more forwards. But some degree of obliquity of the uterus and of the child's body is almost constant. Tarnier describes the uterus as rotated or twisted on its long axis. The uppermost part of the child and the fundus of the uterus usually point to the right of the median line. Hence the axes of the uterus and of the child do not coincide with the axis of the pelvic brim, as Küneke and others, who, basing upon this assumed coincidence, deny Naegele's obliquity, contend.

Reference to Braune and Chiara's sections of frozen bodies taken in labor will show that the axis of the uterus forms with the axis of the pelvic brim an angle of about 15°. This is also proved by Schatz.[1]

The inevitable consequence of this disposition is, that the head, descending along the lumbar incline or upper part of Barnes's curve, enters the brim obliquely as regards the pelvic axis, and not synclitically, as Duncan, Küneke, Leishman, and others postulate.

It is urged that under the action of labor the uterus tends to become more erect, and thus that its axis tends to coincide with the axis of the pelvic brim. That there is such a tendency may be granted, but that cōincidence is attained is not proved. The proper inherent action of the uterus may tend to erection, but the attendant action of the abdominal muscles, powerfully compressing the anterior wall and especially the fundus backwards, must counteract the effect of erection, and carry the axis of the uterus back towards the mother's spine. This Schatz points out as well as ourselves. Again, in primiparæ, the entry of the child's head into the pelvis is often effected before the uterus has entered into active contraction or erection, and whilst its axis is certainly not coincident with that of the uterus. And again, the axis of the uterus is never straight; it is a curved line, answering to the curve of the child's body and to the parturient curve.

It is convenient in this place to describe the *three obliquities of the fœtal head*. These are:

1. *Rœderer's*, or the *occipito-frontal obliquity*. The head may be imagined as rotating on its transverse axis, so that the occiput drops, and therefore dips in the pelvis, standing at a lower level than the sinciput.

2. *Solayrès's obliquity*. Solayrès, in 1771, demonstrated that the head entered the pelvis in an oblique diameter of the brim.

3. The third is *Naegele's obliquity*. Naegele thus describes it: "In that presentation of the head which occurs most frequently, the head presents, not with the occiput, but with the vertex; in fact, with the right parietal bone, the posterior fontanelle being turned towards the left acetabulum. Upon examination at the beginning of the second stage of labor (*i. e.*, when the os uteri is opening), and in those who have had children, the finger introduced in the direction of the central or middle line of the pelvic cavity, and brought in contact with the head, will touch the right parietal bone in the vicinity of its tuber; the two fontanelles are mostly found situated at an equal height, sometimes the anterior, but more frequently the

[1] Der Geburtsmechanismus der Kopfendlagen, 1868.

posterior one a little lower. At the entrance of the pelvis the head does not take a perpendicular, but a perfectly oblique direction; so that the part which lies lowest or deepest is neither the vertex nor the sagittal suture, but the right parietal bone. The sagittal suture is much nearer to the promontorium than to the os pubis, and divides the os uteri, which projects backwards and generally somewhat to the left, across into two very unequal segments."

Naegele enforced this statement by the observation of the caput succedaneum which forms upon the posterior and upper quarter of the right parietal bone (the first position being understood), and if delayed at the outlet, then covering the right parietal bone and a part of the occiput.

Naegele also insisted that the head preserved somewhat of the Solayrès's obliquity even at the outlet of the pelvis and during its exit. This, which was not generally recognized at the time when he wrote, is now universally admitted, Küneke alone excepted. But Naegele further showed that his own obliquity was also preserved to the end. He says: "When the head has sunk completely into the cavity of the pelvis and approaches the external opening, the posterior fontanelle is still found corresponding to the left foramen. . . . The right tuber parietale will be felt distinctly clearing the labia before the left." There must, then, be obliquity of the head at this stage.

These conditions, it will be seen, are incompatible with the *theory of synclitism*—a theory so much insisted upon in recent times. We may in this place briefly explain this theory. The simplest idea or representation of synclitism is obtained by observing the structure and action of a pump. This consists of a straight cylinder and of a piston accurately fitted to it and capable of working up and down. The mouth of the cylinder cut at right angles to the tube represents a plane. We may imagine any number of planes at lower points of the cylinder parallel to this plane of the mouth. The rod of the piston represents the axis of the cylinder. The disk of the piston is set exactly at a right angle to the piston, and, therefore, to the axis of the cylinder. The piston is further set exactly in the centre of the disk, and is fixed there. Now, when the piston is worked down, the disk necessarily standing in the plane of the cylinder, and encountering equal resistance at every point of the circumference, is in stable equilibrium, and its plane keeps parallel with the planes of the cylinder in which it moves. This, then, is synclitism: coincidence of the plane of the disk with the planes of the cylinder which it encounters.

Contrast this case of the pump with that of the uterus, child, and pelvis. The parturient canal is the assumed analogue of the cylinder of the pump. It is not straight, but a sigmoid curve; it is not of equal calibre, but expands under the sacral promontory (see Table, p. 152, and Figs. 64, 65); the driving-force or piston, the uterus, does not work perpendicularly to the plane of the pelvic brim, but at an angle behind it; the disk—that is, the base of the child's head—is not fixed to the driving-force, nor centrally, but is movable upon the piston. The conditions are all contrary to those necessary for the production and maintenance of synclitism.

It is important to note that whilst Küneke contends for synclitism throughout, Duncan, Leishman, and others only contend for synclitism as far as the floor of the pelvis; here parting company with Küneke and joining Naegele in asynclitism to the end.

The Planes of the Uterus and other Soft Parts as Factors in Determining the Position and Course of the Fœtal Head.

Closely associated with the lumbo-sacral curve, and forming integral pa of the parturient curve, are the planes of the uterus and floor of the pelv These, too, have been greatly neglected in the study of the problem. Th are described and figured pp. 425, 426.

We may here supplement this description by adding the suprapelvi plane of the uterus—namely, that formed by the posterior wall of the uteru resting upon the lumbo-promontorial curve. This incline first gives the direction to the head in its descent. Standing at an angle behind the plane of the brim, the head, resting upon the solid incline, necessarily encounters greater resistance at its posterior or sacral side than it does at the anterior or pubic side. This greater resistance is proved by the flattening (amounting at times to indentation) of this side, observed in almost every labor. The driving-force impelling the head onwards makes it rotate to some extent on its long axis, the pubic side describing a larger segment of a circle—that is, the anterior side of the head gets lowest; that is, Naegele's obliquity takes place at the very beginning of labor.

Arrived at this point (the brim), the head must change its course in order to double the sacral promontory. The anterior uterine valve now comes into preponderant work, directing the head back into the sacral hollow. The side of the head in contact with the promontory still encounters the most resistance; the anterior or pubal side moving faster, descends more rapidly—that is, Naegele's obliquity is increased.

Arrived in the cavity of the pelvis, again the head must change its course to clear the outlet by Carus's curve. Now comes the perineal, posterior, or vulvo-vaginal valve—the pelvic floor (see Fig. 114). This directs the head forwards. Although the chief resistance is now encountered by the pubal side of the head, this side still maintains a lower position as regards the planes of the pelvis—that is, Naegele's obliquity is observed throughout the whole course of labor: there is asynclitism from beginning to end.

We may here fitly dispose of *the objections that have been urged against Naegele's doctrine.* The principal objections may be stated as follows:

1. The fundamental objection urged by Küneke, and relied upon by Duncan, Leishman, and others, is that the three axes of the plane of the brim, of the uterus, and of the fœtus, coincide. This, we have seen, is a fundamental error. The axes do not coincide.

2. Subsidiary to the first objection is the assertion of Leishman that Naegele was ignorant of the inclination of the pelvis to the horizon. This is in direct opposition to Naegele's demonstration.

3. That the obliquity in question is not observed, Duncan affirming that "Naegele fell into error from not making the observations relied upon at the brim of the pelvis, and then only." This is simply an arbitrary assumption. Naegele expressly says that he kept his finger on the presenting point at and from the beginning of labor.

4. That it is impossible to find a mechanism to account for it (Duncan); that it would answer no useful purpose (Leishman); that there is always present plenty of room for the head to pass directly (Küneke). These objections resolve themselves into the same thing. We have seen amply adequate mechanism in the form of the parturient canal, in the jutting promontory, in the narrow conjugate diameter of the brim, in the expanding cavity of the pelvis below the promontory, in the shape of the head, and in the action of the uterine planes. We have seen that the head is widest in

its biparietal diameter, and that a clear gain is obtained by substituting the oblique subparieto-superparietal diameter (Galabin).

5. Leishman urges against Naegele his statement that "the higher the head is, the more oblique is its direction, for which reason the ear can generally be felt behind the pubes without difficulty, which could not be the case if the head had a straight direction." We might grant that the obliquity is not greater in proportion to the height of the head, still it would not follow that the head is not oblique at the brim.

6. The situation of the caput succedaneum as seen after birth, invoked by Naegele, is objected to because this swelling varies according to the stage of labor, so that what is produced at the end of labor may be mistaken as the product of causes acting at the commencement. There is some force in this argument; but still it is not contended that the caput succedaneum, as usually observed, is inconsistent with Naegele's theory; and having ourselves made careful observations *ad hoc*, both in propitious and in difficult labors, effected mainly by the forceps, we can affirm that the head seized near or on the brim has been brought through the pelvis, preserving the caput succedaneum as it originally formed over the right tuber and posterior angle of the parietal, no complicating change subsequently occurring.

It might be supposed that this question might be settled by the simple process of observation of a labor in progress. But whether it be under the influence of preconceived theory, or of the inherent difficulty of accurate determination of the relative positions of the parts, observers have come to conflicting conclusions. We, therefore, do not rest the case upon our own clinical experience, conducted through many years under exceptional advantages, and, we hope, with adequate skill and candor. No one can hope to excel Naegele himself as an observer. We, therefore, appeal to the study of the mechanical factors for the solution of this fundamental problem in labor.

We may now sum up the case.

1. Naegele's obliquity is a real, and probably nearly constant, phenomenon in natural labor.

2. It is a necessary result of the combined action and relations of the factors working in the mechanism of labor, namely, the lumbo-sacral curve; the adaptation of uterus and fœtus to this curve through the backward pressure of the abdominal walls; the consequent throwing back of the fundus, and therefore of the axis of the uterus behind the axis of the brim of the pelvis; the jutting of the promontory forwards contracting the conjugate diameter below that of the biparietal diameter of the fœtal head; the consequent facility gained for the head to enter the brim by the substitution of a lesser or oblique diameter; the expansion of the pelvis below the promontory to a nearly circular form, compelling the head in obedience to the law of accommodation to adapt itself to the space under the promontory guided by the anterior uterine plane.

3. As E. Rigby expresses it: "the head enters, passes through, and emerges from the pelvis obliquely; and this is the case not only as to its transverse diameter, but also as to the axis of its brim, the side of the head being always lowest or deepest in the pelvis. This shows the beautiful mechanism of the process, for, on account of its oblique position, there is no moment during the whole labor at which the greatest breadth (still less length) of the head is occupying any of the pelvic diameters."

Naegele examines the cases of other presentations of the head and of the breech, and shows that all are subject to the same law.

NOTE.—The student is recommended to follow the description of the positions the presenting part, and to track them through the pelvis, by help of a fœt-

woman's pelvis. It is better still to do this by using a whole fœtus. If he has n to Budin and Pinard's phantom, the imitation of nature is almost perfect. Fa these, the description may be very fairly realized, by cutting a hole in a card c shape of the pelvic brim, and using with it an artist's jointed lay figure. It i portant to use a fœtus or a whole figure, since much confusion and error arise using only a part of the fœtus—its skull.

Presentation of Cephalic Extremity.

The Head.—There are *four* principal *positions* of the head presentati Of these, two are occipito-anterior and two occipito-posterior.

1. The *right occipito-anterior*, usually called the *first position*, as being most frequent. The forehead is directed to the right sacro-iliac joint, o any rate to a point behind the right end of the transverse diameter. symbol is R. O. A. P.

2. The *left occipito-anterior*, or *second position*. The forehead is dire to the left sacro-iliac joint, or at any rate to a point behind the left en the transverse diameter. Its symbol is L. O. A. P.

3. *Right occipito-posterior position*, or *third position*. The posterior fo nelle is directed to the right sacro-iliac joint. Its symbol is R. O. P. P.

4. *Left occipito-posterior position*, or *fourth*. The posterior fontanell directed to the left sacro-iliac joint. Symbol, L. O. P. P.

5 and 6. *The Head may Present in the Transverse Diameter.*—The occ may be directed to the right or to the left. Thus we have a right a left occipito-lateral position. Practically these positions rarely last be the first stage of labor. When the head descends into the pelvic cavity occiput almost invariably turns forwards or backwards.

The simplest formula for enumerating the head positions is to carry occiput round the circumference of the brim from right to left, begin with the left occipito-anterior position. This then, occiput to left for ovale, being by far the most frequent, may be taken as the type, and is 1. Taking the occiput over the right, we get No. 2. Thus we have th occipito-anterior positions.

Continuing the circuit, the occiput is carried to the right sacro-iliac j this is, No. 3. Still continuing the circuit, we carry the occiput to th sacro-iliac joint; this is No. 4. Thus we have the two occipito-post positions.

This order differs from those sometimes adopted. But we describe the most simple and the easiest to remember: 1 and 2 are occipito-ante 3 and 4 are occipito-posterior. This order is further in accordance natural affinity. Thus the third position tends to resolve itself int nearest anterior position, that is the second; and the fourth in like ma tends to resolve itself into its nearest anterior position, the first. In c case, the occiput tends to come forward, that is, the occipito-posterior tions tend to be converted into occipito-anterior positions. The first fourth positions belong to the left side of the pelvis. The second and positions belong to the right side of the pelvis.

The Face.

The presenting face is recognized by the feel of the nose, lips, jaws, It is generally high up at the beginning of labor, not so easy to rea the vertex.

There are two mento-posterior positions and two mento-anterior c sponding to the positions of the vertex.

The face presentations may be tabulated as follows:

1. The chin is directed to the right sacro-iliac joint = symbol, R. M. P. P.
2. The chin is directed to the left sacro-iliac joint = symbol, L. M. P. P.
3. The chin is directed to the right cotyloid cavity = symbol, R. M. A. P.
4. The chin is directed to the left cotyloid cavity = symbol, L. M. A. P.

If we examine the relations between the vertex and the face presentations, we observe that, holding the skull in the first vertex position, over the brim of the pelvis, lightly poised between finger and thumb on either parietal protuberance, and then letting the face drop, the skull rotates on its transverse axis, we get the first face, or R. M. P. P.

If again, holding the skull in like manner in the second or left occipito-anterior position, we let the face drop, we get the second face or L. M. P. P.

Again, holding the skull in the third, or R. O. P. P., and letting the face drop, we get the third face, or R. M. A. P.

And, holding the skull in the fourth, or L. O. P. P., and letting the face drop, we get the fourth, or R. M. A. P.

Tabulated, the relations are seen as follows:

Vertex.	Face.
1. R. O. A. P. gives rise to	1. R. M. P. P.
2. L. O. A. P. gives rise to	2. L. M. P. P.
3. R. O. P. P. gives rise to	3. R. M. A. P.
4. L. O. P. P. gives rise to	4. L. M. A. P.

Nor is this an arbitrary construction. The conversion of a vertex presentation into a face is what really occurs. Originally postulating a well-formed fœtus, the presentation is very rarely indeed facial. Face presentation is produced by the comparative arrest of the occiput against the lower segment of the uterus and the brim of the pelvis. The broader expanse of the occiput presents greater resistance; the driving force continuing is propagated along the fœtal spine, and the less resisting arm of the head-lever, the face, descends, the skull rotating on its transverse axis.

This happens when there is such obliquity of the uterus that the skull cannot present fairly in the centre of the pelvic brim. It may also happen where an inclined plane is formed on one side of the lower segment of the uterus by the placenta being attached to it. This will throw the skull obliquely over the brim.

Presentations of the Pelvic Extremity. The Breech.

Theoretically we may trace four positions of the breech, as we have done of the skull and face. We may even evolve the four breech positions out of the four typical head positions by a method similar to that by which we have evolved the four face positions. The law of adaptation of the contained and containing parts rules the mechanism of breech-first labors as it does that of head-first labors.

Breech presentation is evolved out of head presentation in the following manner: Suppose the presentation be, primarily, the first vertex. The head, instead of entering the pelvis, slides off to the left ilium. The breech —the other end—of the fœtal ovoid or lever descends in the opposite direction. The child continuing to rotate on its transverse axis, the head and breech at last change places, the head occupying the fundus of the uterus, the breech the inferior segment of the uterus, and presenting over the pelvic brim. This revolution is favored by the frequent inclination of the uterus to the right.

It will be remembered that in the case of the breech, the representative of the longest diameter of the head is the transverse, or bitrochanteric diameter. This diameter then takes up its position in an oblique diameter of the mother's pelvis. Following out the revolution described, the breech will come into the opposite oblique diameter to that which had been occupied by the skull—that is, it will be in the left oblique diameter, the abdomen looking forwards. Each head position has its analogous breech position. Thus the second head is converted into the right sacro-cotyloid of the breech abdomino-anterior; the third head position has its analogue in the left sacro-cotyloid of the breech dorso-anterior, and the fourth head position has its analogue in the right sacro-cotyloid breech dorso-anterior.

FIG. 131.

DORSO-ANTERIOR PRESENTATION OF THE BREECH.

These evolutions have actually been observed in the living subject, and they can be produced by manipulation.

We thus find that there are two abdomino-anterior positions of the breech, and two dorso-anterior. The first two are evolved from the two occipito-anterior positions; the two latter from the occipito-posterior positions; so that there is a change of front of the fœtus.

In practice it is enough to distinguish two breech-positions, namely, dorso-anterior and abdomino-anterior positions, without further differentiation.

The normal attitude of the fœtus, in which the thighs are flexed upon the belly, and the legs flexed upon the thighs, is commonly present in breech presentation.

Knee presentation is simply a variety of the breech. The positions are the same. They are produced by dropping the knees. By a further dropping of the legs, we get corresponding footling positions. The relations of the breech and trunk to the pelvis remain the same.

Another variety is that in which the thighs are flexed upon the belly and the legs extended, so that the feet rest upon the shoulders.

The Trunk. *Arm or Shoulder Presentations.*

If we follow the same process as that described for the production of breech presentations and positions in the case of the trunk, we shall find that the first R. O. A. P. is converted into the left shoulder abdomino-anterior position, the L. O. A. P. becomes the right shoulder abdomino-anterior position, the R. O. P. P. becomes the left shoulder dorso-anterior position, and the L. O. P. P. becomes the right shoulder dorso-anterior position. Thus we find two dorso-anterior and two abdomino-anterior positions of the body, the shoulder being usually the presenting part. The dorsum being forward, the head may lie in the right or in the left iliac fossa; and so, when the abdomen is forward, the head may be to the right or to the left. In practice it is important to distinguish these four positions. The scientific performance of version depends upon making this distinction.

TABLE OF PRESENTATIONS AND POSITIONS, SHOWING THEIR EVOLUTIONS AND MUTUAL RELATIONS.

No. of position.	Head or skull.	Pelvic extremity. Face.	Breech	Knees.	Shoulder.
1.	R. O. A. P.	R. M. P. P.	L. A. A. P.	as breech	L. D. A. P.
2.	L. O. A. P.	L. M. P. P.	R. A. A. P.	"	R. D. A. P.
3.	R. O. P. P.	R. M. A. P.	L. D. A. P.	"	R. A. A. P.
4.	L. O. P. P.	L. M. A. P.	R. D. A. P.	"	L. A. A. P.

This table exhibits the correlative positions of the different presentations, or the evolution of the face-, breech-, and shoulder-positions from the head-positions. It will be seen that the relations of the breech and shoulder to the head are the same. The abdomen in each case is substituted for the occiput.[1]

Complicated presentations are:

1. Presentations or prolapsus of the umbilical cord.
2. Presentations of the placenta.
3. Presentations of uterine tumor or polypus.

Diagnosis of the Attitude of the Fœtus, and of the Presentations and Positions.

When the uterine walls are gently pressed by the flat hands, we soon perceive that the uterine globe offers different resistance in several points. Wherever the liquor amnii is accumulated, the uterine wall yields softly, the fingers feeling little resistance. The same is nearly the case at the seat of the placenta. When, on the contrary, the hand meets a solid part, this, in normal gestation, certainly indicates a fœtal region. From the fifth month, in the great majority of cases, not only do we recognize that a fœtal part is under touch, but with a little practice we distinguish the several parts.

The fœtus is always rolled up on its anterior aspect. The head is known by its forming a mass nearly spherical, regular, large, and very resisting. These characters are marked. The breech presents a voluminous rounded mass which might impose for the head, but it is never so spherical or hard. Moreover, at the side of the breech we nearly always feel the pelvic limbs, or one of them. When in doubt, a comparative examination of the two

[1] The nomenclature or order of the positions above set out differs from that adopted by other authors. The essential thing to remember, however, is not the name or number of a position, but the relations of each position to the pelvis. Our scheme may be called a natural one, inasmuch as all the face-, breech-, and shoulder-positions are shown to flow from the head-positions.

ends of the fœtal ovoid will clear up the difficulty. And cephalic ballottement gives an additional means of distinguishing head from breech; this manœuvre will be described further on. Between the head and breech we find the back. This is sometimes applied directly against the uterine wall, sometimes separated from it by a thin stratum of water which is easily displaced by the hand. It presents a large surface, less hard than the head, nearly flat from side to side, convex in its length. In easy cases the abdominal walls are very thin, and the vertebral column can be traced by almost counting its spinous processes. When the characters presented by the back are obscure, we carry the hand over to the opposite side of the abdomen, where we ought to find a layer of liquor amnii, and in the midst of it we shall make out the prominences formed by the thoracic and pelvic

FIG. 132

DIAGNOSIS OF BREECH PRESENTATION. (After PINARD.)

members; and thus we acquire the conviction that it is the back which we have felt on the other side. Sometimes the back is directed obliquely backwards and to the right, or backwards and to the left; then we can only explore its side and the thorax, which obscures a little the diagnosis. When the back is turned almost directly backwards, it escapes palpation, but then the thoracic and pelvic limbs are felt in front, and we know the back is behind. These limbs correspond to the anterior surface of the child, and indicate its position; they are easily recognized by their smallness and mobility.

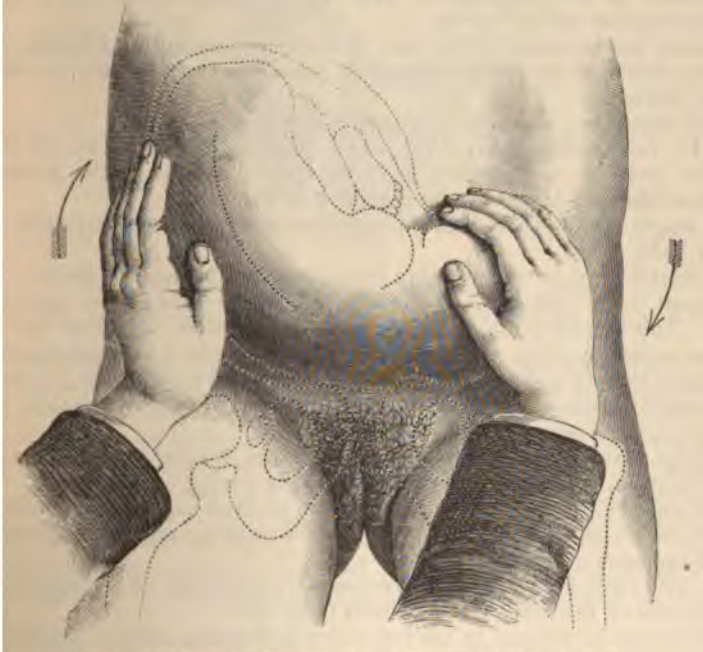
DIAGNOSIS OF THE PRESENTATION OF THE VERTEX.—The hands are applied on either side of the hypogastrium, the finger-tips directed to the groins. Then we depress the abdominal and uterine walls, pressing more strongly with the finger-ends than with the palms, and most frequently the

will be made out by its distinctive character. It is seized between the ands. In primiparæ it will be remembered that the head often dips ly in the pelvic cavity, and that it thus evades superficial exploration hypogastric region. In these cases, we must press the finger-ends the horizontal branches of the pubes, push back deeply the abdominal into the true pelvis, proceeding *from above downwards and from before urds*, and we soon feel a resisting body, the fœtal head filling the cavity. lone, we check the result by examining above for the breech, and the or the back.

GNOSIS OF PRESENTATIONS OF THE FACE.—When we have discovered l-presentation, how can we tell if it be flexed or extended, whether, in it be a vertex or a face presentation? When the vertex presents, els a slight depression between the back and the head at the nucha; on the contrary, the face presents, the occiput is thrown back upon ck, so that between these two parts there exists a considerable depres- asily appreciable to touch, and forming a large sinus quite character- When the face presents, the cephalic tumor, says Pinard, seems to y only one side, or rather one-half of the pelvis; very accessible on the here the occiput is, it seems wanting on the other side.

GNOSIS OF THE PRESENTATIONS OF THE BREECH.—In these presenta- he pelvic cavity is almost always empty, and the fœtal part which is

FIG. 133.



DIAGNOSIS OF SHOULDER PRESENTATION BY PALPATION. (After PINARD.)

t occupies the false pelvis, resting on the brim. Often it is inclined ds one of the iliac fossæ, which it fills. This fœtal part is bulky, but pherical, less regular than the head. The head also gives out the bal- nent more freely. Sometimes the head is so highly placed, that it is en under the xiphoid cartilage. The dorsal and abdominal aspects of

the fœtus present the characters already described. But, again, we must not neglect comparative observations of other parts.

Diagnosis of the Trunk.—In this presentation the flanks are occupied, one by the head, the other by the breech, and by palpation we recognize these parts by the characters described. The back is easily made out when directed forward; it cannot be felt when directed backward, but then the limbs are felt. The outline of the uterus also is altered; its long axis is directed horizontally or obliquely, instead of perpendicularly to the pelvic brim.

Diagnosis of the Positions by Palpation.[1]—In making out the presentations we can hardly fail to make out the positions. The back and the vertebral column of course declare the direction taken by the occiput and the sacrum. In presentations of the face, it will be remembered that the chin looks to the right when the back is turned to the left side, and *vice versâ*.

The Mechanism of Labor in Head-first Presentations.

We have seen in preceding sections that labor—if by this term is meant the passage of the child towards delivery—properly begins before the presenting part enters the pelvic brim. There is a suprapelvic stage. This has been sufficiently described in the section on Naegele's obliquity. It is enough to recall the fact that the presentation and position are greatly determined in this suprapelvic stage by the lumbo-sacral curve and the posterior incline of the uterus.

Bearing this in mind, we may now take up the description of the mechanism of active labor at the point where it is usually begun, namely, on the brim of the pelvis.

Head-first labor is typical of labor generally.

A. In the First Position.—The occiput is directed to the left foramen ovale or cotyloid cavity—that is, in Solayrès's obliquity; the head in its long diameter lies in an oblique diameter of the pelvis.

Six stages may be noted in the process ending in the extrusion of the child's body.

1. On the brim, or just dipping into the brim, the head is slightly flexed, chin upon chest—that is, in Rœderer's obliquity—head flexed upon its own body. This flexion or obliquity in normal conditions is at first very slight. At the same moment, the head is observed slightly inclined upon itself sideways—that is, in Naegele's obliquity—the child's ear which is in relation to the sacral promontory being nearer to its corresponding shoulder than is the case on the opposite or pubic side.
2. Engagement of the head in the pelvis and descent in the cavity.
3. Rotation of the head on its vertical axis during its progress.
4. Emergence of the head from the outlet, its disengagement and extension.
5. Rotation of the shoulders in the pelvis bringing restitution of the head.
6. Expulsion of the trunk.

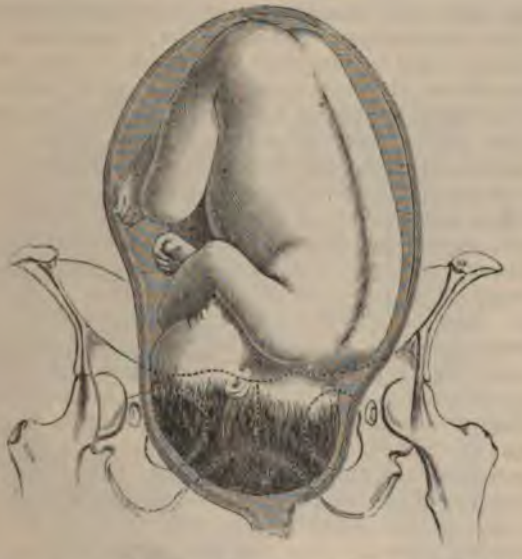
We will now follow these movements: *First stage.* When labor begins the attitude of the fœtus is as depicted (Fig. 134).

The occiput is directed to the left ilium or foramen ovale. The long axis of the child generally coincides with the axis of the uterine cavity. Driving-force applied from the fundus of the uterus upon the breech is propagated

[1] The application of palpation to diagnosis and the rectification of unfavorable positions is worked out with great clearness by Dr. Mundé (see his work, "The Diagnosis and Treatment of Obstetric Cases by External Abdominal Examination and Manipulation," 1880).

along the child's spine and trunk to the neck and head. The head already somewhat flexed upon the chin, and the anterior part of the lower segment of the uterus offering less resistance than the posterior, the frontal or longer arm of the head-lever either remains stationary or rises relatively, whilst the occipital or short arm is thrust down into the pelvic brim. Thus we have the *first stage*, flexion. This is the beginning of the *second stage*, or engagement of head in pelvis. Two forces concur in directing the head in its descent. One is the inclined plane formed by the anterior wall of the lower segment of the uterus which directs the head backwards towards the pelvic floor, the other is the expanding cavity of the sacrum under the pro-

Fig. 134.



Presentation of Vertex in Right Oblique Diameter. (Pinard.)
1st stage. Flexion and commencement of 2d stage or engagement in pelvis. 1st position.

montory offering least resistance. Hence the head descends nearly to the pelvic floor with Naegele's obliquity rather increasing as the head revolves a little on its long axis to find accommodation where there is most space. At this stage the examining finger, passed centrally in the axis of the pelvis, impinges upon the right parietal protuberance, generally, in primiparæ almost constantly, capped by the lower segment—Bandl's segment—of the uterus. To reach the os uteri and to touch the head directly, the finger must pass further back or higher up nearer to the promontory.

Flexion and engagement of the head in the pelvis sometimes take place simultaneously; and in the case of primiparæ commonly before active labor sets in.

Third Stage. Movement of Rotation.—During the descent of the head into the pelvis, the finger applied to the presenting part, takes note of a curious screw-like or spiral movement. Under the down-driving pressure, the occiput seems to come down a little forward; when the uterus relaxes, a movement of restitution, or of rising and turning a little backwards, occurs. This is repeated until at last the presenting part gets under the pubic arch. Naegele contended that the part which first emerges under the pubic arch is

not strictly the occiput. It certainly is not the central part of the occiput, but the upper and posterior angle of the parietal bone, and the adjacent part of the occipital—that is, the head—does not emerge strictly with its long axis coincident with the external conjugate, but obliquely. It preserves, in short, a certain measure of the original obliquity—Solayres's obliquity—with which it presented at the brim (see Fig. 113).

At what moment does the rotation-movement take place? We think this is not constant. In primiparæ the head may, as we have seen, get to the pelvic floor almost before active labor begins. In this case there is little or no rotation until the labor sets in. Under the driving-force the head is then compelled to adapt itself to the form of the parturient canal, especially of the pelvis, and so the occiput comes forward. Up to this time the head may have undergone little or no moulding; the liquor amnii being still present, protects it. But the membranes bursting, the driving-force becomes more efficient, and as the head is compelled to advance, it bores its way, finding the route which affords the most room, adapting itself partly by moulding, and partly guided by the shape of the pelvic canal. The transverse diameter of the outlet and of near the outlet narrows, whilst the oblique and conjugate diameters expand, and thus the head-ovoid turns its longer diameters in these longer pelvic diameters—that is, the occiput comes forwards, whilst the forehead and face turn more to the sacral hollow. Tyler-Smith, as we have seen, insisted that the sciatic spine was a main factor in directing the occiput forward. Tarnier explains that the rotation is determined by the unequal length of the two arms of the head-lever.

Fourth stage. Extension, Deflection, or Disengagement.—It is during this movement that the greatest amount of elongation by moulding takes place. The liquor amnii has commonly been discharged, and the plastic head having to traverse a tight musculo-tendinous ring, is exposed to the greatest amount of pressure. As the head engages in the outlet, the trunk engages in the pelvic cavity. The chin is still pressed upon the chest when the presenting part gets under the pubic arch, even until the bregma appears at the posterior commissure of the vulva. At this moment the perineum, acting like an elastic belt, on the one hand pushes the head up towards the pubes, and on the other slips quickly over the face, which it leaves bare, whilst it runs back towards the coccyx. The occiput now being fixed under the pubic arch, on-driving force causes the anterior arm of the head-lever to descend—that is, to revolve round the pubic arch, causing the occiput to rise. This is extension, and marks the liberation of the head. It is a movement of rotation of the head on its transverse axis (see Fig. 114).

At the outlet the three obliquities of the head are still observed. Thus the part that emerges first under the pubic arch is not the middle of the occiput, but the posterior angle of the right parietal bone; the median point of the occiput lies to the left of the vulva, not centrally; and there is still some degree of flexion of chin upon chest.

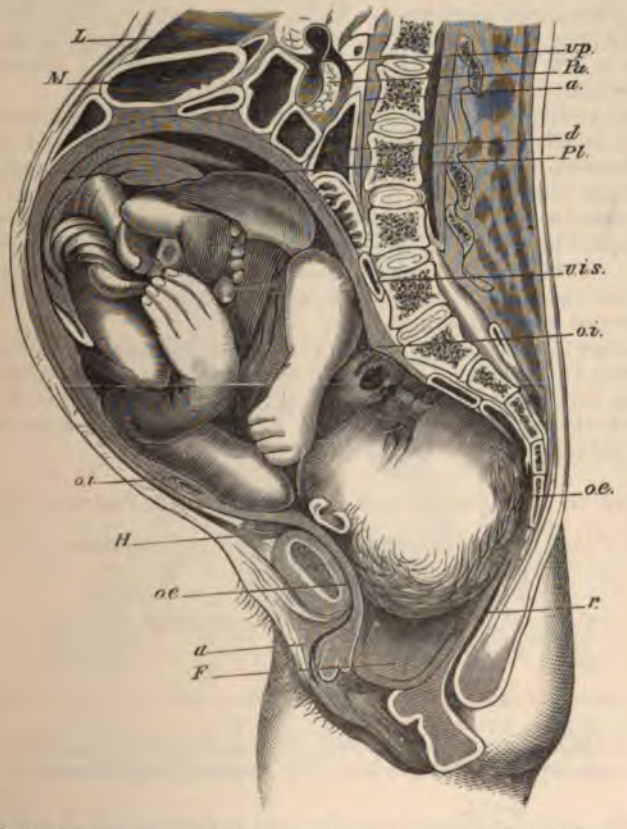
Fifth stage. Restitution or rotation of the expelled part on its long axis next takes place, in accordance with a similar rotation of the body still in the genital canal. The body, driven on by the uterine contractions, encounters different degrees of resistance on its anterior and posterior surface, and in consequence it rotates as it moves on. But this rotation of the body is not complete, for, as Schatz explains, the part of the body highest in the uterus keeps, in relation to the part which is lowest, about 30° behind. There results a torsion of the fruit-cylinder or whole length of the body, in which even the body of the uterus shares.

After the birth of the head, the shoulders adjusting themselves to the long diameter of the outlet, just as the head had done, the effect is to turn

he head, now liberated, round in the opposite direction—that is, the child's ack being directed to the mother's left side, the face will look to the inside f the mother's right thigh.

The delivery of the shoulder is then effected under the continuing riving-force; and since the trunk is flexed in correspondence with the axis of the pelvis, the force will tell more upon the hinder part, increasing its convexity backwards, and, therefore, forcing the hinder shoulder downwards; the anterior shoulder, the right, gets under the pubic arch, and is relatively fixed, just as the occiput was; the hinder shoulder moving on along the perineum is treated in the same manner as the face had been, and is gradually turned out of the vulva, sometimes first, but generally following the anterior or pubic shoulder. The chest then follows with its transverse diameter nearly corresponding to the conjugate of the pelvic outlet.

FIG. 135



BRAUNE'S FROZEN SECTION SHOWING LEFT OCCIPITO-ANTERIOR POSITION. HEAD ENGAGED IN PELVIS. 2D POSITION.

oi. Os internum. *oe.* Os externum. *r.* Rectum.

6. The *birth of the breech* follows under a new rotation of the long axis of the body, which brings the transverse axis of the breech into the left oblique diameter of the pelvis. There is rarely any difficulty in the transit of the breech. The passages have been fully distended by and trunk. The

breech is commonly aided in the delivery by the obstetrist, who draws upon the shoulders and trunk.

B. The Right Occipito-anterior Position.—The description left occipito-anterior position applies to this, it being simply nece reverse the terms right for left. It involves no material difference course of the labor.

Moulding of head in head-first labors; occipito-anterior. The effected in these positions are as follows:

The following diameters are shortened: the T. T., the S. B., and th In consequence the suboccipito-bregmatic circumference is reduced.

The following diameters are lengthened: O. F. and O. M.; and i quence the occipito-frontal circumference is increased. The bi diameter is constant. Generally, then, the transverse diameters are sh and the longitudinal diameters are lengthened.

Fig. 129, showing these changes in a marked form, should be co with Fig. 128, of the ideal head. F. M. is increased to 5.25″, the 6.50″. We have seen it extended to 7.0″. This is an extreme case; elongation to 5.30″ or 6.0″ of the O. M. is by no means rare. These n ments come near to those commonly given as the normal.

The head undergoes a great part of its occipital elongation during stage—that is, when it is emerging under the pubic arch, and ha moulded between this part and the vulva and perineum and coccyx.

The occiput emerges first; the presenting part, as it parts the v near the posterior fontanelle. The effect of this is that the skull is in suboccipital-bregmatic diameter—that is, in the circumference diameter. At this part the skull exhibits marked plasticity, so that driving force causes the occiput to point more, and the occipito-fro occipito-mental are increased.

It is curious to observe how, under elongation, the angle of interse the O. F. and O. M. varies. The angle seems to be a measure of the tion. Thus, looking at Fig. 128 of normal head, the O. F. and O. M. angle of about 45°; whilst, looking at Fig. 129, we see the two li proaching coincidence forming an angle of 30° or less.

Adaptations of Pelvis and Fœtal Skull and their Obstetric Re

Adaptations of skull modified by moulding to successive planes of pelvis. Scale

Pelvis.			Skull.	
Brim.				
Conj.	4.25–4.50,	corresponds to	biparietal,	3.75–4.00
Transv.	5.00–5.25,	"	O. F.	4.60–5.00
Obliq.	5.00,	"	S. B.	4.25–4.50
Cavity.				
Conj.	4.75–5.00,	"	P. P.	3.75–3.50
Transv.	4.75,	"	O. F.	4.50–4.75
Obliq.	4.75–5.25,	"	S. B.	3.75–4.00
Outlet.				
Conj.	4.25–5.25,	"	O. F.	4.75–5.25
Transv.	4.25,	"	S. B.	3.75
Obliq.	4.25–4.50,	"	P. P. merging into T. T.	3.50 3.25–3.50

This table is no doubt open to criticism. There is no possibility of fixed or constant terms. Pelves and heads differ in proportion, in pla and in other properties; but, allowing for variations, and something

theoretical assumption, this table conveys much useful information and suggestion. In appreciating it the following points will be borne in mind. The correspondence of fœtal and pelvic diameters is approximate only. The long diameters of the head are rarely opposed to the diameters of the pelvis. The head traverses somewhat axially—that is, the long axis of the head-ovoid inclines to coincidence with the axis of the pelvic canal. To a less marked degree, but still appreciably, the extreme transverse diameters of the head also avoid direct apposition to the pelvic diameters. The head enters, and traverses somewhat canted or slewed. Under the helicine progression of the head the relations undergo partial changes.

C. Occipito-posterior Positions.—There is equally elongation of the occiput; but there is greater depression or flattening of the region round the anterior fontanelle.

The *course of labor with occipito-posterior position* presents features distinct from that of labor with the occiput anterior.

There are two occipito-posterior positions: R 3, numbered consecutively from 1 and 2, the occipito-anterior. In this the occiput is directed to the

Fig. 136.

Presentation of Vertex in Left Oblique Diameter, Occipito-anterior. 2d position. (Pinard.)

right sacro-iliac synchrondrosis; the long diameter of the head, therefore, lies in the right oblique diameter of the pelvis, and is the reverse of the first position.

According to our experience the occipito-posterior positions are more frequent when the promontory is comparatively flattened. Under this condition the occiput tends more readily to turn backwards as it descends. We have known this position recur in the entire series of labors of the same woman; so that, having occurred in a first labor, it may be expected to recur in subsequent labors. The general effect is that the labor is rendered more tedious; it more frequently calls for aid by forceps.

A remarkable phenomenon is the strong tendency the occipito-posterior positions manifest to be converted into occipito-anterior p

advances. In the case of the third position, now under study, this tendency is so great that Naegele affirms that it is at an early stage more frequent than is the second position; and that a large proportion of apparent second positions began as third positions.

This tendency of the occiput to come forwards is one instance of the general law which tends to compel the dorsum of the child to turn forwards. It rules in breech and shoulder presentations. It is a result of that law by which Robert Barnes explains the production of the ordinary position of the fœtus in utero before labor—namely, the more easy adaptation of the con-

FIG. 137.

PRESENTATION OF VERTEX IN RIGHT OBLIQUE DIAMETER, OCCIPITO-POSTERIOR. THIRD POSITION. (Pa

cave and yielding anterior aspect of the body to the resisting convexity of the spinal column. Thus we see that when this spinal convexity is slight the occiput more easily glides backwards.

It is convenient to premise some general phenomena common to both the occipito-posterior positions. First, as we have seen, both tried to pass into the nearest occipito-anterior position. Secondly, the original occipito-posterior position may persist to the end of labor.

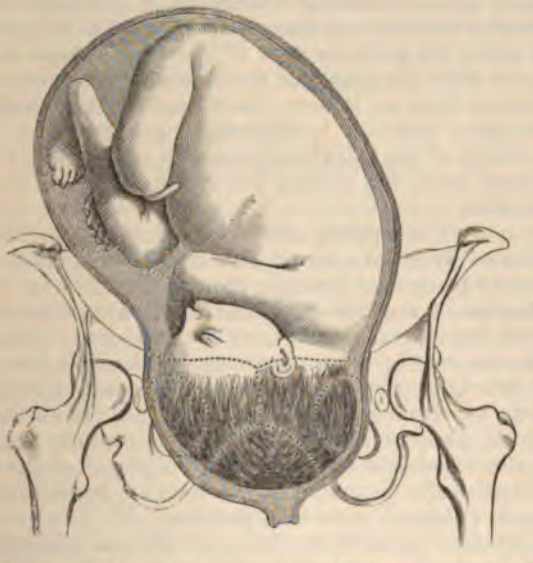
We need not dwell upon the first case, since being resolved into the anterior occipital positions, the history becomes that of the positions into which they are resolved. It need only be noted that this conversion takes place, in many cases, when the vault of the cranium has reached the floor of the pelvis. The factors which determine this rotation are complex. The occiput, descending, meets the spine of the right ischium and the attached ligaments, when instead of passing behind this prominence, it passes in front of it, and, directed by the ischiatic planes, passes downwards and forwards, until it occupies the second position. We believe an important factor is the action of the psoas-iliacal muscle of the side in relation to the occiput; this, bellying out under the reflex voluntary contraction of the expulsive stage, will push the broad expanse of the occiput forward, and thrust it within the range of the ischiatic planes.

Some experiments of Dubois in relation to this phenomenon are especially interesting. A woman died in childbed; the uterus, of large size, was opened down to the cervix, and held in a suitable position over the pelvic brim; the fœtus was then placed in the right occipito-posterior position. The fœtus then, pushed from above, readily entered the cavity of the pelvis; much greater effort was necessary to make the head roll over the perineum and clear the vulva; but, in three successive attempts, when the head had traversed the internal genital organs, the occiput had turned to the right anterior position, the face having turned to the left and backwards—that is, rotation had taken place as in natural labor. Subsequent experiments showed that when the perineum and vulva had lost their firmness, the rotation forward did not take place.

This observation is in entire accordance with what we have described as the action of the pelvic floor, or perineal valve. This forms an inclined plane, guiding the presenting part under the pubic arch.

When the occiput retains its posterior position, it tends to roll up under the promontory, adapting its convexity to the sacral hollow. This involves a degree of rotation on its transverse axis, so that the forehead descends behind the opposite foramen ovale. This extension of the head brings its

FIG. 138.



VERTEX IN LEFT OBLIQUE DIAMETER, OCCIPITO-POSTERIOR. FOURTH POSITION. (PINARD.)

long diameters into unfavorable relation with the diameters of the pelvis. The extension of the head, occiput turning up under the promontory, is analogous to the natural extension of the occiput under the pubes. But in occipito-posterior position, the occiput can hardly escape from the pelvis. It becomes lodged in the hollow of the sacrum and on the floor of the pelvis, and driving-force acting in greater degree upon the anterior arm of the head-lever tends to increase the difficulty. After a time, however, the three factors of labor under mutual adaptation may effect delivery, the occipito-posterior position being preserved. The driving-force continues—resisting parts of the parturient canal yield; the head r

gradually, the forehead gets under the pubic arch, and a little more space is gained for the long diameter of the head; the forehead then becoming more fixed serves as a fulcrum to the rod represented by the long diameter of the head; the occiput then feels the preponderant force of the driving-power; it descends, distends the pelvic floor and perineum, and at last emerges. As soon as the equator of the head, sometimes even earlier, has passed the vulva, flexion ceases, extension begins, and the nose, mouth, and chin successively appear, the occiput rolls back over the perineum. In this process the perineum undergoes excessive distention. Thus laceration of this structure is more frequent than in occipito-anterior positions.

D. The Fourth Position, we have seen, occupies the same relation to the first that the third does to the second. It evinces the like tendency to be converted into the first, and by a similar mechanism.

Tyler-Smith observes that in the first and third positions, the most common, the head occupies the right oblique diameter of the pelvis. He submits that the greater frequency of the right oblique positions is due to the occupation of the posterior part of the left oblique diameter by the rectum. The bulging of this organ may be enough to deflect the occiput or sinciput to the right.

We have noted the spiral or screw-like rotation of the head. Tyler-Smith describes this with his usual felicity. The pelvis, he says, represents a portion of a female screw, admitting a male screw (the fœtal head). But the male and female screws are not accurately adjusted at all points. It is only at the points where the posterior part of the parietal bone or of the occiput comes in contact with the planes of the ischium and pubes that the thread of the male screw bites, as it were, the thread of the female screw. It is here that the spiral direction is impressed upon the fœtal cranium. The line of this portion of the spiral may be made out by chalking the salient point of the fœtal head, and moving it through the pelvis in the direction it takes in parturition.

The two halves of the pelvis also represent portions of two screws, the inclined planes of which are arranged in opposite directions. Thus, if the head be placed in the second position, the spiral movement is reversed from that which obtains in the first position, and the long diameter of the fœtal cranium moves from the transverse, or left oblique, to the antero-posterior diameter. In the case of labor occurring in the first, the right shoulder moves upon the right portion of the spiral or screw, formed by the right ischium and pelvic bone, and glides down it, just as the head does in the second position. In the second position, on the contrary, after the delivery of the head, the left shoulder rotates upon the planes of the screw or spiral of the left side of the pelvis, and passes out with a movement similar to that which belongs to the head in the first position.

Perhaps, continues Tyler-Smith, the screw or spiral movement is seen still more distinctly in the common terminations of the third and fourth positions. Here, rather more than one-fourth of a circle is completed in the movement which brings the occiput from the right or left sacro-iliac joint to the right or left ramus of the pubic arch.

Other positions of the head are sometimes described. Thus we may have a right and a left transverse position, according as the occiput is supposed to be directed to the right or left ilium. That these positions occur, there is no doubt; but they are almost invariably transitory, soon merging into one or other oblique position. It has been said further that the head may present with its occipito-frontal diameter in the conjugate diameter of the pelvis. This position can hardly occur, or be maintained in a normal pelvis, the head being of normal size. If the child be premature, very small, or dead, the

head may present in this or in any other way; or it may occur in the kyphotic pelvis. But such cases do not fall under the mechanism of normal labor.

Summary of Mechanism of Labor in Head Presentations.

VERTEX PRESENTING. Six stages: 1. Flexion; 2. Engagement or descent in pelvis; 3. Rotation; 4. Disengagement or extension; 5. Rotation of shoulders, with restitution of head; 6. Expulsion of trunk.

First four stages apply to head, last two to trunk.

1. *Flexion*, chin flexed upon chest.
2. *Descent* of head in pelvis.
3. *Rotation*, occiput coming forward as head descends near floor of pelvis.
4. *Extension, progression, and liberation*, movement round symphysis pubis in Carus's curve or axis of pelvis.
5. *Interior rotation of shoulders and trunk, exterior rotation of head, restitution.*
6. *Liberation of the trunk*, progression of shoulders and trunk in Carus's curve.

Under Pajot's law of accommodation, presenting part undergoes successive *changes of shape* and *position*, in relation to the pelvic canal.

Dilatation of cervix uteri. "Canalization" of parturient passages.

Stretching of floor of pelvis. Dilatation of vulva.

During 2d, 3d, and 4th stages, head undergoes moulding in adaptation to pelvic and utero-vaginal canals.

There is a definite position of head for each plane of the pelvis. The head follows a screw movement.

Mechanism of Face Presentations.

Face presentations occupy a doubtful or intermediate place between normal or propitious, and abnormal or unpropitious labors.

A considerable proportion terminate happily for mother and child under spontaneous labor. But the labor is commonly tedious, protracted, and not seldom calls for artificial aid, and brings the child and mother into danger.

Let us take in the first place the two mento-posterior positions. Of these we will first trace the mechanism observed in the *right mento-posterior position*, which is the natural outcome of the first or right occipito-anterior position.

HOW PRODUCED.—The theories put forward are various and conflicting. Hecker submitted that it was due to extreme preëxisting elongation of the head, the dolico-cephalic head. This theory, we believe, rests upon defective observation and erroneous interpretation of facts. The shape of the head invoked as the cause of the face presentation is in reality the effect of the labor in this presentation. Hecker supposes that the increased power of the occipital arm of the lever throws the face down. From photographs and outline tracings of heads born after face and other varieties of labor, we are in a position to demonstrate Hecker's error. It is true that in face-labors the head is found elongated; but it is easy to trace this altered form to the compression undergone during labor. There is no evidence to show that it exists before labor. Fig. 113 shows the common globular shape of the head before labor. Fig. 136, taken from a photograph of an actual case, represents the dolico-cephalic condition produced during its compression in its transit through the pelvis.

Brow presentations may be regarded as transitional between vertex and face presentations; and by analyzing the mode in which brow and face presentations arise, we shall have the best indications for prevention and

treatment. Let us consider the head as a lever of the third order, the power acting about the middle. The fronto-occipital diameter or axis represents the lever; the atlanto-occipital articulation is the seat of the power. Riding upon this point, the head moves in seesaw backwards and forwards. A force too little noticed in obstetrics is *friction*. If friction were uniform at all points of the circumference of the head, it would be of minor importance, from a purely dynamic point of view, to regard it. But it is rarely so. Friction at one point of the head may be so much greater than elsewhere, that the head at the point of greatest resistance is retarded, whilst at the opposite point the head will advance to a greater extent. The head then must change its position in relation to the pelvis. Let us then take the case where excess of friction bears upon the occiput when in relation with the left foramen ovale. This point will be relatively fixed, whilst the opposite point or forehead, receiving the full impact of the force propagated through the spine to the atlanto-occipital hinge, will descend—that is, the forehead—will take the place of the vertex, and be the presenting part. If this process be continued, the head rotating back more and more upon its transverse axis, the face succeeds to the forehead.

A condition that singularly favors this excess of occipital friction, and consequent rotation in extension, is the *lateral obliquity of the uterus*. The want of coincidence between the axis of the uterus and child, and of the axis of the pelvic brim, disturbs the equilibrium of resistance and friction. Thus we see that the production of face-presentations is due to the operation of the

FIG. 139.

FACE PRESENTATION IN THE FIRST POSITION AT THE BRIM. MENTO-POSTERIOR.

same mechanical law as that which produces Naegele's obliquity of the he
In both cases there is angular relation of the axis of the uterus and fetus
the axis of the pelvic brim, and therefore unequal resistance, and therefo
greater descent of that part of the head to which the least resistance is o
posed—that is, there is produced obliquity of the head, on its occipito-fron
diameter in Naegele's obliquity, on its biparietal diameter in the case o
face presentation or obliquity.

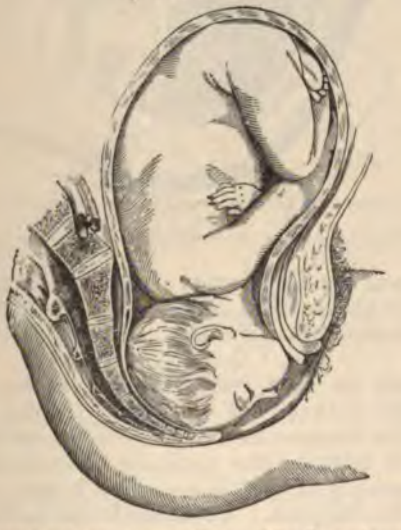
This demonstration is further proved by its application to practice in rectifying the vicious position. If we can transpose the greatest friction or resistance to the forehead, and still maintain the driving-force, it is clear that the occiput must descend, and the normal condition may be restored. In practice this is actually done. When at an early stage of labor we find the forehead presenting, we can, by applying the tips of two fingers to the forehead, retard its descent, and the occiput comes down. This effected, the rest will probably go on naturally, because the atlanto-occipital joint being somewhat nearer the occipital than the frontal end of the lever, the shorter or occipital arm will keep lowest. But if there should still be excess of resistance at the occipital end, we have only to add so much resistance to the frontal end as will maintain the lower in equilibrium.

It is at the same time desirable to restore the due relations between the axis of the uterus and the axis of the pelvis. This is best done by placing the patient on her back and supporting the uterus in the median line by the hands.

It is also possible by timely adjustment and support of the uterus before the advent of labor to correct the tendency to malposition of the child and thus to avert face presentation.

As in the case of the cranial presentation, there are four positions, and these may be described as conversions or accidental departures from the re-

FIG. 140.



ROTATION FORWARDS OF THE CHIN. (After TYLER-SMITH.)

spective cranial positions. Thus, taking the first cranial position, in which the occiput is directed to the left foramen ovale: the occiput, instead of descending into the pelvic cavity, hitches upon the edge of the brim, or is kept up from some other cause, whilst the driving-force continuing, the head rotates on its transverse axis, and the forehead and face successively come lowermost. Thus is formed the *first face-position*. The *second face-position* is formed in a precisely similar manner, the forehead coming to the right foramen ovale, and the fronto-mental line of the face lying in the second or left oblique diameter of the pelvis. The *third* and *fourth face-*

positions may in like manner be traced to third and fourth cranial positions. In all the cases the forehead takes the place of, and represents, the occiput.

Progress of Face Presentations.—In the position described the head might very well proceed through the pelvic cavity and outlet, following corresponding rotations to those observed in cranial positions, *if the head only had to travel.* But the child's trunk must follow; and it is this which causes the difficulty, and which compels a change. The student's attention to this point is especially invited, because the too common mode of teaching and examination in the mechanism of labor in this country is to use simply a

Fig. 141.

Passage of the Head through the External Parts in Face Presentations. (After Tyler-Smith.)

The head is becoming flexed and sweeping over the perinæum.

pelvis and skull; and thus he is apt to neglect the part which the body plays in this case. Reference to Fig. 142 will place the difficulty clearly before the mind's eye, and show what it is that has to be overcome by nature or by art.

We see, then, that the head, rolled back in extreme extension, is pressed down upon the back between the shoulders (see Fig. 142). Thus there is opposed to the pelvic diameter not alone the fronto-occipital diameters of the child's head, but, in addition, the thickness of its chest. The sum of these two exceeds the capacity of the pelvis. This is made more evident by the triangle traced in the diagram. A B is the fronto-mental diameter; A C and B C, the two other sides of the triangle, represent the relative dimensions of the body which has to pass; A thus is the wedge, B C the base of the triangle. The wedge cannot proceed, because the base greatly exceeds the available space. Here, then, is the difficulty. Unless the relations of the factors of the problem be changed, the head will become locked, labor comes to a standstill, the fœtus may perish of asphyxia, and the mother of exhaustion or rupture of the uterus. Let us see how Nature extricates herself.

Three following events are possible:

1. The head and trunk may undergo such moulding under long compression that the base of the wedge may be so far lessened as to permit of

onward progression. But this event, rare in any case, can hardly happen unless the child be very small in proportion to the pelvis, or dead, in which latter case it may be crushed down to adaptation.

2. The wedge formed by head and trunk may be decomposed—that is, the occiput, quitting the relation of extreme extension, may descend, and flexion being restored, the head is brought into natural relation to the axis of the child's body. This decomposition may be effected in two ways:

The body and head rotating, the chin comes round to the pubes, and there getting under the arch, space is gained behind in which the occiput can descend. Flexion proceeds. The wedge is decomposed. This is the most frequent natural termination.

3. The wedge penetrates some distance into the pelvic cavity, the child undergoing greater compression, and probably perishing in the process. The chin does not come forward to the shallow pubic side of the pelvis, so as to be liberated, but maintaining its posterior position, puts the perineum and pelvic floor enormously on the stretch, until at last the chin rides over the fourchette and coccyx, then the wedge gets decomposed by the occiput descending, flexion being restored. In the first case, that in which the chin

FIG. 142.

SHOWING FACE PRESENTATION (MENTO-POSTERIOR) ENGAGED IN PELVIS AND ELONGATION OF HEAD. (ROBERT BARNES.)

A, B, C. Wedge formed by head and chest. A. Apex of wedge.

comes forward, the chin or lower jaw, comparatively fixed under the pubic arch, forms the centre of evolution of the head; the face, forehead, vault of cranium, and occiput successively emerge in Carus's curve, thus we have a counterpart of the course of labor in occipito-anterior positions. In the second case, the chin or lower jaw, escaping over the fourchette, becomes comparatively fixed under the coccyx, which now represents the centre of evolution, and the face, forehead, vault of cranium, and occiput, following the curve D E (Fig. 132); succesively emerge backwards; flexion being thus restored, and the wedge decomposed, the difficulty is overcome.

We thus find a third curve to add to Barnes's curve—the promontorial, and to Carus's curve—the pubic. This third or perineal curve has lately attracted special attention in connection with the study of axis-traction and the use of Aveling's and Tarnier's forceps.

We may now trace the successive steps of the rotation chin forwards. We must begin by warning the student not to accept his idea from a favorite diagram of Schultze, copied into most recent text-books. We may take as the type the first or most frequent face position—mento-posterior in the right oblique diameter of the pelvis. In this case, at the beginning of labor extension of the head or descent of the face is in progress. This may take place before the membranes are ruptured. On examination the presenting part is more difficult to reach than in ordinary cranial positions; the brim of the pelvis is not so well filled; the lower segment of the uterus is not so expanded; the finger passed through the os uteri, instead of feeling the broad, firm expanse of the cranial vault and a fontanelle, feels an irregular surface which, under more searching, is resolved into nose, mouth, and chin. At this stage the fronto-mental diameter may approach the transverse diameter of the pelvis.

The root of the nose crosses the os uteri exactly in the same manner as the sagittal suture does in the corresponding cranial position. The right eye and zygoma is that part of the face which is lowest in the pelvis. This is the part touched by the finger in examining. It represents the right parietal protuberance of the first cranial position. It is upon this part that the analogue of the caput succedaneum, the swelling, forms. This part is the first that presses through the os externum. As descent continues, extension increases; the chin gets lower, and represents the apex of the wedge; as the base of the wedge tries to engage in the pelvic brim, the occiput is driven into the back, and, under a process of flattening of the cranial vault along the vertex, the laryngo-bregmatic diameter is lessened; the chest at the same time is lessened in its antero-posterior diameter; and thus the base of the wedge may be so far moulded that it can descend some way into the cavity. When it has descended as far as the mechanical obstacle will allow—and this is sometimes nearly to the floor of the pelvis—the process of accommodation by rotation sets in.

The chin comes forward under the right branch of the pubic arch, the face during the whole process preserving a strictly oblique position both as to the transverse diameter, and the axis of the pelvis. The forces, static and active, which determine this rotation, are assumed to be the same as those which determine the anterior screw rotation of the occiput in cranial positions. But we believe that the principal guiding movement is effected nearer to or at the brim of the pelvis. The base of the wedge formed by head and chest under the driving-force is turned round, and necessarily the face turns round with it. If we adopt absolutely the intrapelvic origin of the rotation, we must imagine either that the head is twisted on its neck, changing its relation to its chest—a circumstance hard to realize when we remember how tightly the parts are jammed—or we must imagine that the movement began at the chin or face, the point of the wedge being powerful enough to cause the whole wedge to rotate. It seems to us more reasonable to conclude that the maximum moving power resides in the larger part of the body—that is, in the base of the wedge rather than in its apex.

The *second position of the face* is merely the reverse of the first. It is now the left side which is turned forwards, the left eye and zygomatic process being lowest in the pelvis; the chin is turned to the left side, and advances to the left foramen ovale and left branch of the pubic arch. The left cheek

first enters the os externum and presents the swelling. The chin passes under the left branch of the pubic arch.

In the *third* and *fourth* positions, or the mento-anterior, it will be noted that the chin is already nearer to the pubic arch, and has consequently a much shorter distance to travel in its rotation towards liberation, than is the case with the mento-posterior positions. In the mento-anterior positions the chin only traverses about the eighth of the pelvic circle, whereas the mento-posterior chin has to travel about one-fourth of the circle or twice the distance. This is one cause of the greater ease with which labor is accomplished in the mento-anterior positions. Another favorable condition is that the trunk more easily adapts itself against the yielding abdominal wall, so that the wedging is less firm. But in truth the mento-anterior positions are comparatively rare. This will be understood when we remember that they are the outcome of occipito-posterior positions, themselves comparatively rare. We are not for this reason to conclude that the liberation of the head by the forward rotation of the chin is a very serious difficulty. It takes place in the great majority of instances perfectly well, if let alone. It is a case in which it may be said that Nature abhors assistance.

SUMMARY OF MECHANISM OF FACE PRESENTATIONS.

A. *Mento-anterior positions.*
   1st stage. *Extension of head*, occiput fixed, face descending.
   2. *Engagement or descent of head into pelvis.*
   3. *Rotation of head*, chin coming forwards.
   4. *Disengagement or liberation of head.*
   5. *Interior rotation of trunk.*
   6. *Expulsion of the trunk.*

B. *Mento-posterior positions.*
   1. *Extension of head.*
   2. *Engagement or descent of head into pelvis.*
   3. *Rotation of head.* { 1. Chin coming forwards. / 2. Chin moving more backwards.
   4. *Disengagement or liberation of head.*
      1. Chin under pubes.
      2. Chin under coccyx.
   5. *Interior rotation of trunk.*
   6. *Expulsion of trunk.*

MANAGEMENT OF FACE PRESENTATIONS.—Now that the sufficiency of Nature is recognized, operative interference is much restricted. It is eminently a case for patience. Turning was at one time much resorted to. This operation can hardly be carried out with safety when the labor is advanced, when the presenting parts are jammed in the pelvic cavity. And if practised early in labor, when the face is at the brim, no opportunity is given for Nature to do her work. Here, as in many other cases, premature interference actually confirms the presumption of ignorance, by shutting out that knowledge which comes from the observation of Nature. By waiting, we might see the chin come forward. The questions arise: 1. Can we usefully convert a face presentation into its original cranial presentation? 2. Failing this conversion, can we promote the forward chin-rotation? 3. Is there a residuum of cases in which the chin will neither come forward, nor effect its liberation by getting over the perineum and coccyx.

1. The first question, that of the expediency of restoring the original cranial presentation by bringing down the occiput, has been referred to as the most seemingly rational proceeding. If we could transpose the greatest resistance to the anterior pole of the fœtal head, the occiput would, supposing the continuance of adequate driving-force, come down before the face. The

difficulty would be averted. Such a proceeding could only be carried out at an early stage—that is before the face-position is completed; and at this stage, the imperfect dilatation of the lower segment of the uterus and of the cervix will oppose an almost insurmountable obstacle. But Dr. John Clarke believed that the position could be rectified by manipulation at a later stage. He waited until the head had descended into the cavity of the pelvis, and then exerting steady pressure upwards and backwards upon the presenting cheek during each pain, he succeeded in lodging the face in the hollow of the sacrum. Thus he said the labor would terminate as in vertex cases. We have tried this method, using as much pressure as we thought justifiable, without accomplishing the object. We may say that considerable force would be necessary, more than can safely be employed, to decompose the wedge in this way. Baudelocque advised another proceeding. The hand was carried through the os uteri, into the space between the brim of the pelvis and the forehead of the fœtus; the membranes were then ruptured, and the fingers seizing the vault and then the occiput of the child, the attempt was made to bring down the occiput, and thus to substitute a cranial position. The proceeding is violent,—difficult, when not impossible, to carry out, likely to excite dangerous contractions of the uterus, extremely likely to favor the descent of the cord; and, above all, it is superfluous. Similar attempts have been made to bring down the occiput by help of the lever. This is open to similar objections. We conclude then that it is wiser not to attempt the restitution to a cranial position.

2. We come next to the second question, that of the expediency of helping the chin forward in the path indicated by Nature. Some good may be done in this way. A finger may sometimes be passed into the child's mouth, and gentle traction made towards the pubic arch during the pains. Very little force *à fronte* thus added to the driving-force may give the desired advance.

3. The third question is how to deal with the residual case in which Nature is unequal to complete her task. This question, we have seen, can hardly arise until the labor has made some progress; therefore we assume that we have to deal with cases in which the face is low in the pelvic cavity, and arrest or impaction has occurred. This may arise as in cranial positions from the inertia of exhaustion from disproportion.

Should the labor be arrested when the chin is in course of rotation forwards, the forceps may be usefully applied. The mode of doing this will be described in the part specially devoted to operations. We need only say here, that the head must be well seized over the hinder part, and traction made downwards and forwards. When there is arrest, the chin remaining posterior, it is sometimes sufficient to put on a little *vis à fronte* by forceps, in the same way as in the preceding case. As onward movement is imparted, the chin may come forwards as it does under the natural *vis à tergo*. But if this be not observed, the chin should be brought over the perineum and coccyx, as occurs sometimes under the natural efforts. This we have successfully carried out.

There are still cases in which exhaustion, arrest, perhaps impaction of the child, dictate a severer course. The urgency may compel us to resort to craniotomy. By this proceeding, the difficulty is met by reducing the bulk of the wedge; and it also becomes easier to decompose the wedge, altering the position of the head element. But this, the ultimate resource, is rarely necessary.

At one time it was a general practice to turn in face presentations. To accomplish this, the operation must be undertaken before the head has descended into the pelvic brim, and at this stage the presumption is still strongly in favor of the sufficiency of nature—that is, the operation is

uncalled far. On the other hand, when the head and chest-wedge have got impacted in the pelvis, the operation is so difficult as to entail serious danger to the mother, without giving reasonable expectation of saving the child. The cases that justify turning, then, are exceptional.

When the head is born the rest of the body behaves as in cranial presentations. The right shoulder, being lowest, is driven against the anterior surface of the spine of the right ischium, and rotated from right to left, so as to place the shoulder nearly in the antero-posterior diameter of the outlet of the pelvis. The right shoulder is thus born first, the left sweeps over the perineum. The hips follow in like manner.

The aspect of the child born under face presentation attracts special attention. The livid swelling over the presenting parts gives it a frightful appearance, causing, perhaps, a shock to the assistants, and suggesting to the ignorant the suspicion that it was injured by the obstetrist.

A charge of malpractice might, in ignorance or malice, be based upon this natural phenomenon. The swelling has for its centre, commonly, the malar bone that was lowest, hence it spreads over the nose and eye, the lid may be enormously swollen, reminding one of a black eye from a pugilistic encounter. The mouth is involved in the swelling, the lips being large and livid. This is especially the case when delivery is effected chin posteriorly. Some idea of this may be acquired from Fig. 142, taken from an actual case. The swelling forming more on one side, by distorting the features, makes the general appearance more hideous.

Fortunately the swelling quickly subsides. In the course of three or four days little remains to be seen, beyond a little discoloration from ecchymosis. Fomentations with warm water constitute the treatment.

The deformation of the cranium bears most upon the vertex. This part is depressed against the symphysis pubis; bulging of the occiput ensues. The general appearance is represented in Fig. 142.

Children born dead from the compression the head has undergone during labor, have exhibited marks of cerebral congestion. This was found in several cases by Chaussier and by Naegele. The singular and great deformation of the skull produced in these cases must almost necessarily entail some injury to the brain.

The immediate effect of face labor upon the mother is the greater risk of laceration of the perineum, and the greater friction involves greater bruising of the parturient canal. These traumatic injuries, added to the exhaustion of protracted labor upon the woman, expose her to more risk of puerperal complications. Still the ultimate result is hardly more serious than that of normal cranial labor. Experience justifies Boer's dictum, uttered in 1793, that face presentations, being merely a rarer form of natural labor, should be left to the natural efforts, since neither the mothers nor the children were exposed to any more danger than in ordinary labor. He says, that of 80 cases which he himself observed, three, or at most four of the children were born dead. None of the mothers suffered, yet all were left to Nature.

This instructive quotation fitly sums up the history of face-labors.

Forehead Presentations.—These are intermediate between cranial and face presentations. We may suppose the progress towards a face presentation to stop half-way; the rotation of the skull on its transverse diameter ceases when the forehead is over the brim. In this position one of three things may happen: 1. The position may be nearly preserved. 2. The rotation occiput backwards may continue, and a complete face presentation may result; or 3. The rotation may be reversed, and the cranial position may be regained.

Under this theory, of forehead presentation being a stage towards face presentation, we find four corresponding forehead presentations, the head occupying one or other oblique diameter, and being either anterior or posterior.

In our experience forehead presentation is especially liable to occur in pelves approaching to the kyphotic type, in which the sacral promontory juts less than usual. In such cases the forehead may lie close behind the symphysis pubis, the position being in the conjugate diameter.

The cases in which the forehead is anterior—and they are the most common—resemble in some respects the occipito-posterior positions of the cranium. Similar treatment is indicated. It is sometimes described as "face to pubes." The forehead taking a *point d'appui* against the symphysis, the indication is to bring down the occiput. This is done by applying the long forceps, one blade over each ear, and then making traction in Carus's curve, at first well backwards, then, as the occiput descends, carrying the handles well forwards.

Presentations of the Pelvic Extremity.

Presentations of the pelvic end of the long axis of the fœtal body coinciding with the axis of the parturient canal fall under the conditions of natural labor. Labor may be completed by the natural forces with safety

FIG. 143.

SHOWING DORSO-ANTERIOR POSITION OF BREECH. (After RAMSBOTHAM.)

to mother and child. The dynamics ruling in head and face presentations rule here. The law of accommodation is equally evident in its operation.

FREQUENCY.—Pinard found that in mature births the proportion of breech presentations was 1 in 62. Perhaps 1 in 80 is the rule.

Causes.—In the first place we may note that the attitude of the fœtus as regards the disposition of its limbs is commonly the same as when the head presents. The difference is that, instead of the head being lowermost, the breech is lowermost. The attitudes are correctly given in Figs. 143 and 144, after Ramsbotham. There is the same general condition of flexion—head upon chest, spine curved forwards, arms and hands flexed upon themselves and upon the chest, legs flexed upon thighs, thighs flexed upon abdomen. The general result is that the child is packed in the least space, and forms an ovoid.

Such is the usual and normal attitude; but most text-books continue to reproduce, as the type of breech-attitudes, a diagram which represents the

Fig. 144.

Abdomino-anterior Position of Breech. (After Ramsbotham.)

legs in extension, so that the toes touch the shoulders. This attitude is exceptional, and gives rise, as we shall see, to very difficult labor, commonly compelling resort to a difficult operation to effect delivery.

The conditions that favor breech presentation are: Excess of liquor amnii, so that the fœtus, whilst relatively small, may revolve in utero; laxity of the uterine walls and abdominal walls; multiple, especially twin pregnancies, the fœtuses, accommodating themselves in the containing space so as to occupy the least room, will usually be disposed so that one has its head lowest in relation to the other's breech. Now, when the head-presenting fœtus is born, its fellow will present by the breech. This is a simple matter of mutual accommodation. Then there are obliquity of the uterus: jutting promontory

of the sacrum; implantation of the placenta in the lower segment of the uterus.

Under excess of liquor amnii and lax condition of the uterus and abdominal walls the fœtus easily changes its position. The researches of Wigand, D'Outrepont, Credé, Hecker, Valenta, and especially of Esterlè,[1] prove that the fœtus frequently undergoes spontaneous changes of position; also that the position may be changed with great facility in the later months by external manipulation. It is not difficult to understand that the fœtus may change from head to breech under external impressions more or less accidental. Women encounter shocks, succussions, pressure on the abdomen and uterus from various forms of exertion, from stays which press unduly on the fundus uteri, and direct pressure under coitus, which, the fœtus being unusually mobile, may cause it to revolve. If we imagine an original head presentation existing in the eighth month of gestation, liquor amnii in excess,

FIG. 145.

DORSO-ANTERIOR BREECH-POSITION NATES NEAR OUTLET. TRUNK CURVED, CORRESPONDING WITH PARTURIENT CANAL.

and the uterus deflected, say, as is not unusual, to the right, apply pressure continuously or in a series of succussions to the lower pole of the uterus so as to bear upon the head, the head will rise, the breech will in equal degree descend. If the moving impulse be discontinued before the head has risen above the equator of the uterus, it may descend and right itself, or it may remain in the iliac fossa, the shoulder coming over the pelvic brim, constituting a shoulder or so-called transverse presentation. But if the head has been pushed up above the equator of the uterus, even when the pressure is withdrawn the head will hardly descend to its original place. The lever formed by the child's body is now grasped by the uterus, naturally of an ovoid form, and constantly tending, after interference, to recover this form in such a way that the head-arm of the lever is carried higher up, and the breech-arm lower down, accommodation between the fœtal ovoid being thus reëstablished, substituting a breech for a head presentation.

The force acting is twofold: 1. The restitution-force inherent in the uterus, which constantly tends to regain its natural ovoid shape after distention; this is due to elasticity or resiliency of tissue, which may be compared to the action of an India-rubber bottle after distention. 2. To active muscular contraction, which again tends to restore the ovoid shape.

Another condition we have observed is the implantation of the placenta

[1] "Sul rivolgimento esterno," Annali Universali di Medicina, 1859.

upon one side of the lower segment of the uterus. An inclined plane is thus formed, along which the fœtal head and shoulder are guided across to the opposite side of the pelvis. If the process stop short at the shoulder, we have a transverse presentation; if it go to lift the head above the equator of the uterus, the breech will be carried to the fundus of the uterus.

Positions.—As in cranial and face presentations, we may describe four positions of the breech; and these may be divided into two dorso-anterior and two dorso-posterior.

The Abdomino-anterior Positions.—The first is that which arises out of the first cranial position, L. A. A. P., in the way described (page 507). We will trace its progress through the pelvis. Referring to the diagram, we observe that the bitrochanteric diameter of the breech lies in the left oblique diameter of the pelvis abdomen-anterior. The breech represents the head. The side nearest to the promontory meeting more resistance, and the axis of uterus and fœtus lying behind the axis of the pelvic brim, there is necessarily obliquity of the breech, analogous to Naegele's obliquity of the head. Thus the anterior or right ischium stands lowest in the pelvis, just as the anterior parietal bone does in the cranial presentation. Driving-force impelling progress, the breech engages in the pelvic cavity, revolving round and under the promontory in Barnes's curve, and continuing in the same position nearly to the floor of the pelvis. Then, encountering the same conditions which cause the rotation of the head in a helicine course, bringing the occiput forward, the anterior ischium comes a little forward under the pubic arch and presses against it; the other ischium, which has to make a greater circuit in Carus's curve, passes forward over the strongly distended perineum, so that when the breech is born the abdomen of the child will be directed to the inner and posterior surface of the mother's left thigh. It must not, however, be supposed that rotation takes place to an equal extent as in cranial presentations. The breech preserves more of its original obliquity to the end. Naegele insisted much upon this. Two other conditions call for description. One is the "balling" or moulding of the breech; the component parts of the breech are yielding, and, under compression, undergo concentric moulding—a process for which we suggest the word "balling" as appropriate. The other condition is the serpentine figure imparted to the long axis of the child to fit it to the parturient curve (see Fig. 145).

The rest of the trunk follows in this position, and as the breast approaches the outlet the shoulders press through the brim in the same or left oblique diameter as that into which the breech entered. Then the head, resting in flexion upon the chest, passes the brim in the right oblique diameter, the occiput directed to the right sacro-iliac joint. Then the head, descending into the cavity, follows the law of head-presentations. The occiput comes round to the pubic arch, then the chin and face sweep the pelvic floor, flexion being restored.

Closely following, almost accompanying the breech, come the feet and legs. When the whole pelvic extremity is born, if the process is left to nature, the arms appear placed upon the chest, the elbows preceding the shoulders.

In the second abdomino-anterior breech-position, R. A. A. P. (see table, p. 509), which springs from the second cranial, the bitrochanteric diameter lies in the right oblique diameter of the pelvis, the right ischium being in relation with the right sacro-iliac joint. The breech descends in like manner, obliquely; the nearest or lowest ischium, the left, gets under the pubic arch, and emerges first; whilst the hinder one, taking a larger curve, sweeps over the perineum. The feet and knees appear flexed, then the trunk, then the flexed arms, then the shoulders, which have passed through the same oblique

diameter—the right, as the breech—are delivered. The head, which has passed through the opposite or left oblique diameter, comes down; the occiput comes under the pubic arch, a little obliquely, and the chin and face sweep the perineum.

The *two dorso-anterior positions* are the most favorable, and the most frequent. They spring out of the third and fourth cranial positions. There is no inconsistency in this statement. According to Naegele, the third position, occipito-posterior, is much more frequent than is the second position, occipito-anterior. It may well be, then, that the third position, which is so remarkably disposed to change, may more frequently than the other presentations result in breech presentation.

The third breech, or L. D. A. P. (see table, p. 509), has its bitrochanteric diameter in the left oblique diameter, its left ischium anterior and lowest. Descending thus into the pelvic cavity, the left ischium rotates a little forwards, gets under the right ramus of the pubic arch; the opposite ischium sweeps the perineum, the back of the fœtus looks obliquely forwards; the feet and knees emerge nearly with the breech, the trunk follows in the same direction, arms and chest are delivered; the shoulders, which have passed through the left oblique diameter, then pass the vulva, preserving something of the original obliquity, but approaching the conjugate diameter of the outlet, so that the abdomen, when born, looks towards the mother's right thigh or buttock; the head, then, having passed through the brim in the right oblique diameter, engages with its occiput under the pubic arch, with its long diameter approaching the conjugate diameter of the pelvic outlet; the chin and face then sweep the perineum.

The fourth, or R. D. A. P., springs from the fourth cranial. It follows a similar course to the other dorso-anterior position, simply substituting left for right.

The mechanism of breech labor may be summed up in six steps:

1. Balling or moulding of the breech.
2. Engagement and descent of breech; lateral or sigmoid flexion of the trunk.
3. Rotation of breech and trunk.
4. Disengagement of breech.
5. Interior rotation of head.
6. Expulsion of head.

Naegele and Collins stated it as a law in nates presentations, that, whatever may be the direction of the child in the abdomino-posterior positions at the beginning of labor, it will always, if not interfered with, be found with its anterior surface turned towards one or other sacro-iliac joint, when the thorax or the shoulders are beginning to pass through the outlet of the pelvis. When the nates have once passed the vulva, the position of the child frequently varies a good deal, the abdomen turning first to one side and then to the other. This is especially the case in the second, or R. A. A. P., where it is more or less forwards; nevertheless, as labor advances, it will, almost invariably turn obliquely backwards, and be born in this position.

The Management of Ordinary Breech-labor.

Having traced the mechanism of labor in the several breech positions, we may follow the clinical history. In a considerable proportion of breech presentations, the labor sets in prematurely, without much warning. If we have the opportunity of examining before the membranes have burst, we may find the lower segment of the uterus resting on the pelvic brim, but not much dipping into it. Instead of the firm globular expanse of the head

we find something different, a more conical presenting part, less firm, not so accurately blocking the os internum; the shape of the bag of membranes is more pointed. Not finding the head in its expected place, we seek for it by palpation of the abdomen, where it may generally be felt at the fundus of the uterus; auscultation will point to the situation of the heart, at a higher level than is usual in head presentations (see Figs. 133, 134). Returning then to vaginal examination, we feel for the characteristic features of the breech. These are: the ischial tuberosities, rounded bumps, one of which, the anterior, is lower in the pelvis than the other; between the tuberosities we feel a soft depression or groove; at one end of this groove we touch the genital organs. In the male, the testicles, scrotum, and penis are not difficult to distinguish; in either sex, carrying the finger backward, we feel the anus, coccyx, and the ridged lower end of the sacrum. This last mark is very characteristic. It further tells us whether the position is dorso-anterior or dorso-posterior.

The rupture of the membranes takes place in a manner somewhat different from that observed in head presentations. In these last, the inferior segment of the uterus forms a pouch, accurately filled by the head. Thus, when the bag bursts, there is a sudden gush of water, then the flow is stopped by the head driven down like a ball-valve. In breech cases, the gush is not so sudden; the waters continue to flow until the uterus is nearly emptied.

When the membranes have ruptured, as is not seldom the case, early in labor, before the cervix is far expanded, the preceding marks are more easily made out. But care should be taken not to examine too frequently or roughly, lest the child's genitals be bruised. At this time the equivalent of the caput succedaneum, in the shape of tumefaction, is formed upon the presenting part, which is gripped by the cervix uteri. This tells especially upon the scrotum, the loose tissue of which readily becomes infiltrated. Thus the characters of the parts may be obscured.

At this stage, meconium may escape with the discharges. This is almost conclusive evidence of breech presentation. The voiding of meconium is held to be a respiratory act. It implies some difficulty in the equivalent of air-respiration, namely, in the utero-placental circulation. This may arise from compression of the umbilical cord, or from compression of the placenta upon the child's head by the contracting uterus. This denial of oxygenated blood compels the fœtus to seek for air. The effort, consequent upon this *besoin de respirer*, induces reflex movements, which result in the evacuation of the urine and meconium. Meconium then appearing in the discharges, gives warning that the child is in danger, and is an indication to accelerate the delivery. This warning is often accentuated by another cognate phenomenon; twitching of the child's legs—a reflex movement. We must not, however, allow ourselves to be hurried into precipitate action. The child will not be rescued by such action. We have repeatedly seen children born alive several minutes, fifteen or more, after the appearance of meconium.

Meconium is also often voided by a purely mechanical process of squeezing. This takes place when the child's abdomen is being tightly grasped by the vagina and vulva. Meconium is then seen to be squeezed out, the nates being outside the vulva.

One rule, before resorting to accelerative measures involving traction, should be rigidly observed. It is to secure, in the first place, adequate dilatation of the cervix uteri, so that the chest and head may pass easily. If extraction be made before this facility is attained, the child will probably be lost, and the mother may suffer contusion and laceration. If then the membranes point too conically, so that the presenting part cannot enter to dilate the cervix, or if, after rupture of the membranes, the cervix remains unex-

panded, dilate by means of Barnes's bags. These will accomplish the end without violence.

When the labor is premature, it often progresses rapidly from this point; the uterine action and respondent respiratory abdominal action assume a stormy character, and the child may be expelled so rapidly that little or no time is allowed for observation or assistance. In such cases the child is likely to be born living. This stormy action of the uterus, Tyler-Smith explains as the result of the quick and complete escape of the liquor amnii. The inner surface of the uterus is thus brought into multiplied points of contact with the body of the fœtus; and the diastaltic function is excited in proportion.

In other cases, mainly of full-sized children, the labor in the first stage is tedious. The breech is not so well adapted as the head to expand the cervix uteri. The passage through the pelvis may not exceed the time observed in head-labors. If any undue delay occur when the breech is engaged in the outlet, the wedge formed by the breech and legs may be decomposed by gently drawing down one foot—the one nearest the perineum is the best—and bringing it outside. This sensibly diminishes the bulk that has to pass; if, then, at the same time that we exercise gentle traction upon this leg, wrapped in a diaper, in the direction of the axis of the brim, we get an assistant to exercise steady pressure upon the fundus uteri downwards, the progress of the labor is much facilitated, and without injurious interference.

Another manœuvre may sometimes be practised when the breech hangs at the outlet. The index finger may be insinuated into the posterior groin of the fœtus, and gentle traction made in the direction of Carus's curve. We say this may *sometimes* be done; but we believe the practice is unscientific. It does not fulfil the great condition of decomposing the wedge formed by the breech and thighs; and should the legs be extended—and we cannot know without passing the hand into the pelvis if this is the case or not—the difficulty is increased by pulling the wedge tighter into the pelvis. When describing the operation of turning, we shall show how to overcome this difficulty by bringing down a foot.

We must scrupulously abstain from more interference than this if possible, for, the breech delivered, two complications easily provoked by injudicious meddling are at hand; the first is derangement of the orderly mechanism of the labor—that is, disturbance of the due relation between the parts of the child and that zone of the pelvic cavity which it is occupying. This is the evil that is produced by what is called "giving the turns." Some over-diligent obstetrists not realizing the great law of adaptation, yet knowing that the child commonly rotates back forwards, think they are helping nature by putting a rotating force upon the limb unfortunately in their hold, and by its means trying to twist the body round—a vicious practice condemned by sound theory and experience. We have in the "obstetric operations" dwelt with necessary emphasis upon the rule that all traction must be simple traction in the axis of the pelvis, giving progression only, and leaving nature to accomplish the rotations in her own way, as she will infallibly do under her law of accommodation, if not thwarted by superfluous help. This rule applies to the forceps as well as to extraction by the pelvic extremity.

At this time, the *cord comes within danger of compression*. When the umbilicus is below the pelvic brim, it is liable to be jammed between the child's body and the side of the pelvis, and thus, its circulation being obstructed, the child may die of asphyxia. How is this danger to be averted? If we find the cord well pulsating we may give time for the full dilatation of the passage above, so as to permit of the rapid passage of the head. It is

obvious that the risk of injurious pressure is even greater from the head, which is harder, larger, and more apt to be delayed. Two things may be done: 1. Draw down gently a small loop of cord, so as to take off tension upon the umbilicus; 2. If you can, push the cord over to one side of the promontory, where it will be to some extent protected in the hollow from pressure.

Now watch the cord; so long as it pulsates well, and the labor advances, wait. If, on the other hand, the pulsation flag or cease, and the labor is suspended, we are justified in accelerating delivery. There are two chief ways of doing this: 1st, *by traction on the legs* and trunk aided by pushing force above; 2d, *by forceps*, equally aided by pushing. In some cases traction may offer the quickest relief. The operation will be described under the head of "Turning." In other cases, the forceps is the quickest. It is generally the safest, the surest, and should, in our opinion, be preferred. This operation, the application of the forceps to the after-coming head, will also be described in another place.

The arms may run up by the side of the head. If the labor march by itself, the arms will usually pass flexed upon the chest. But if the labor be in any way hurried, and especially if attempts be made to give the turns, one or other arm hitching upon the brim of the pelvis will be delayed, whilst the head is carried down. The arm or arms thus applied to the side of the head form a wedge too large to pass through the pelvis. Hence the arrest of labor, and increased danger to the child from compression of the cord. The indication, again, is clear to decompose the wedge. This is done by passing the hand into the pelvis, carrying the index up along the child's back so as to reach the scapula and shoulder, then slipping the finger over the acromion and down the humerus; this is thrown in flexion across the child's chest, restoring the natural relations. When this is done, the head is free, and can advance either under natural propulsion, under gentle traction, or by aid of forceps. This operation we have described as *the liberation of the arms*.

This operation will be described in detail and illustrated in the chapters on "Turning," and "Dystocia" from certain difficult breech labors.

When the arms and chest have passed, the chin may hitch upon the brim; then, extension being produced, the proper mechanism of the labor is disordered. It is another consequence of prematurely pulling upon the legs or "giving the turns." The method of dealing with this will be described when relating the history of dystocia in head-last labors.

During the passage of the chest and head the trunk should be supported; and it is well to wrap it in a warm diaper. Care should be taken in handling the child during labor to interpose a soft cloth between the fingers and its limbs. The child is in danger from four causes: 1. From compression of the cord between its chest or head and the pelvic wall; 2. From delay in labor from arms running up by the sides of the head; 3. From compression of the placenta between the child's head and the contracting uterus; 4. From constriction of the child's neck by the lower section of the uterus.

In all these cases compression of the cord is an almost necessary complication; 2 and 4 are especially due to untimely and vicious interference. Pulling upon the child disturbs the harmony of relation between the child and the passages, and throws the action of the uterus into disorder, inducing perhaps a tetanoid condition, or excessive spasmodic action of the lower segment, and so strangling the child.

We do not here dwell upon other dangers to the child resulting from injudicious practice, as these will be pointed out in the chapter on "Turning."

The statistics of mortality whether of mothers or children, usually stated

are vitiated by several fallacies. A leading one is that they are compiled from tables made up of the most discordant cases, which defy analysis and right appreciation. Thus the tables deduce included cases in which the Nature, but art was responsible for the death. We cannot justly count, as an item showing the risk to the life of the child, a death which was caused by dragging the child forth, "giving turns," setting up tetanoid action of the uterus, or other forms of malpractice. If we could ascertain the proportion of children born dead under ordinary conditions without undue interference, we might arrive at the true mortality. This would certainly considerably exceed the proportion of stillbirths in ordinary head-first labors, but it would probably fall far short of the mortality resulting from the inclusion of cases treated *nimiâ diligentiâ*.

The risk to the mother in breech labors in ordinary cases is not great, probably not much exceeding that of head-first labors. Inasmuch as the labor is more protracted, this factor must be reckoned upon as a danger in puerpery.

The risk of laceration is hardly greater than in head-first labor. Rupture or laceration of the uterus or vagina are more often due to the operator's manœuvres than to spontaneous action. The perineum is more likely to rend under the passage of the head.

The head in breech labors commonly escapes with little deformation. The passages have been well dilated by the breech and trunk, and thus the head undergoes comparatively little compression. It preserves, in fact, very nearly its primitive spherical shape. Spiegelberg advances that the spherical shape is due to the pressure exerted by the genital canal upon the circumference of the head, whilst the absence of pressure from above leads to increased bulging of the convexity of the cranium. The theory is ingenious, but we are convinced, from close observation of the course of these labors, and measurements of heads taken after every variety of labor, that the explanation we have given is correct and sufficient. The head, escaping undue pressure, simply preserves its natural sphericity.

The equivalent of the caput succedaneum presents itself upon the presenting breech. The main swelling is formed upon that part which was lowest in the pelvis, and therefore upon the anterior buttock, extending to and involving the genitals. The scrotum is often remarkably swollen, œdematous, even ecchymosed, of a dark livid color, greatly disfigured. This appearance is apt to give rise to the suspicion of mismanagement of the labor, if not of culpable injury, by the obstetrist. Suspicion of this kind rouses a strange feeling of resentment in the minds of the female attendants. It is wise, therefore, to warn them beforehand of what may be expected as the usual consequence of breech labors, and fears of future mischief may be allayed by the confident assurance that all this shocking appearance will disappear in a few days. No special treatment is required.

Knee and footling presentations are simply modifications of the breech presentations. We have only to imagine that in an original breech presentation the legs drop away from the trunk, and we get the knees or feet presenting. The positions of these presentations are the same as those of the breech. There are two dorso-anterior and two abdomino-anterior. They are especially apt to occur when the child is dead or premature.

The diagnosis is only certain when we feel the parts. But there is a peculiar condition of the bag of membranes. This points more conically; it does not so easily dilate the cervix; the presenting part is higher, more difficult to reach. But when the liquor amnii escapes, and even before, we may commonly feel a knee or foot. We should not be content with merely detecting a foot; we should proceed to determine how it lies. The heel

corresponds to the child's back; the toes to its abdomen. Thus we may tell whether the position is a dorsal or an abdominal anterior.

The Mechanism and Natural History of Labor in Oblique or so-called Transverse Presentations.

The history of presentations, entitled under the various terms of oblique, transverse, cross, shoulder, arm, trunk, is full of physiological and clinical interest. The key to the right understanding of this history lies in the careful observation of Nature. We must enter upon the study with candid minds, free from all prejudgments, accepting in the first place the facts as Nature presents them as the foundation of theory, and then upon these facts constructing such theories as the facts will sustain. We shall by this method arrive at fairly definite therapeutical indications, showing us how far we may safely trust to Nature, and when and how Art may be best invoked. This principle applies, indeed, to all the great problems in medicine; but it does so with especial force to this one, which has been so much obscured and complicated by practices that have prevented Nature from demonstrating her resources and her power. Contrary to the order followed by most writers, we give a place to the transverse presentations in the section devoted to the mechanism of ordinary labor. These presentations stand in such physiological connection with the more strictly normal presentations, that they are more likely to be correctly understood in their pathological bearings if studied in this connection. Another reason for this arrangement is that transverse presentations are not necessarily causes of dystocia. Some cases, perhaps more frequent than is commonly believed, terminate by the natural powers. The cases which require the intervention of art will be studied under the heads of "Dystocia" and "Turning," and other operations.

The Causes of Transverse Presentations.—The factors which act in the production of vicious presentations, and the modes in which they act, logically demand the first attention. In discussing the origin of breech presentations we have pointed out that, in the later months of gestation, the fœtus may easily, under conditions inherent in the woman or fœtus, or accidental influences from without, change its position.

1. The fundamental question is: *What are the factors which determine the ordinary position of the fœtus in utero?* This question has been answered in preceding chapters, if not completely, at any rate with some degree of fulness.

2. The next question will be: *What are the conditions which produce the frequent changes from the ordinary position?*

3. A third question is: *What are the powers of Nature, or rather the methods employed by Nature, in dealing with unfavorable positions of the fœtus?*

It is convenient to begin by describing the several varieties of malposition of the fœtus which are observed.

As in the cases of head and breech presentations, so in transverse presentations there are two principal orders:

A. Dorso-anterior. { 1. Right arm to left. 2. Left arm to right.

B. Abdomino-anterior. { 1. Right arm to right. 2. Left arm to left.

Reference to Table p. 509 will show the evolutional relation of the several shoulder or transverse positions to those of the head out of which they are assumed to arise. The two dorso-anterior positions arise out of the two occipito-anterior positions. This will be understood by observing what takes place when deflecting the head from the brim towards the iliac fossa, the

first stage in the production of breech presentation. When the head is thus fairly lodged in the iliac fossa, the shoulder comes over the brim; the presentation is now oblique, or of the shoulder; the dorsum looking forward. Conversely, the two abdomino-anterior positions arise out of the two occipito-posterior positions.

For practical purposes it may be enough to recognize the grand distinction between dorso-anterior and abdomino-anterior positions, without considering further differentiations; but to obtain a fair physiological idea of the matter, it is necessary to describe the varieties. We describe, then, the *two dorso-anterior positions* (see Table, p. 509):

1. In the one, L. D. A. P., the head being deflected into the left iliac fossa, the right shoulder comes over the brim, whilst the breech occupies the right side of the body of the uterus, rising out of the iliac fossa, the dorsum looking forwards.

2. In the other, R. D. A. P., the head is deflected into the right iliac fossa, the left shoulder comes over the brim, whilst the breech occupies the left side of the body of the uterus, rising out of the iliac fossa, the dorsum looking forwards.

The two abdomino-anterior positions:

3. In the R. A. A. P. the head is deflected to the right iliac fossa; the right shoulder comes over the brim; the breech occupies the left iliac fossa; the abdomen looks forwards.

4. In the L. A. A. P. the head passes into the left iliac fossa; the left shoulder comes over the brim; the breech occupies the right iliac fossa.

In most cases, early in labor, it will be found on examination that the position is more oblique than transverse. It becomes more transverse as labor advances and the shoulder or arm is driven into the pelvis. True transverse positions are necessarily rare. The long axis of the child bends at the neck—that is, much nearer to one end; thus, the head bends upon the shoulders and finds accommodation in an iliac fossa, whilst the trunk and breech, forming the longest part, must find accommodation at a higher level in the fundus of the uterus. The position is therefore oblique.

We may now return to our second question: *What are the conditions which produce the frequent changes from the ordinary position?*

Any considerable disturbance in the equilibrium of the factors which keep the fœtus in its due position, of course, favors malposition. The following are the principal disturbing conditions: *Excess of liquor amnii.* This acts in two ways: (*a*) it favors increased mobility of the fœtus; (*b*) it tends to destroy the elliptical and flattened form of the uterus. The middle zone of the uterus increasing in greater proportion than the long diameter, the cavity becomes more spherical. Hence the fœtus is no longer kept in perpendicular relation to the brim of the pelvis, for want of the proper relations between its form and size and those of the uterus. It easily revolves when any moderate force is applied; and if at such a moment the membranes burst, the fœtus may be fixed in its unfavorable position by the contracting uterus. 2. *Obliquity of the uterus* was held by Deventer to be a main cause of malposition. Latterly it has been somewhat discredited; but we believe it to be a very effective factor. Wigand, Dubois, and Pajot demonstrated that deviation of the uterus to the right greatly preponderates over every other position. Referring to the description given of Naegele's obliquity of the fœtal head, and its relation to obliquity of the axis of the uterus in relation to the axis of the pelvic brim, we shall see how the more decided and vicious obliquities of the fœtus are consequences of the same laws operating under exaggerated conditions. As the uterus grows during pregnancy, rising above the pelvic brim, the projecting sacrovertebral angle and the curve of the lumbar column

deflect its fundus to one or other side; and if the abdominal walls be very thin and flaccid, as happens in some multiparæ, the fundus uteri will fall forwards. The tendency of these obliquities, if carried beyond ordinary measure, is to throw the axis of the uterus further out of the axis of the brim, and to bring some other part than the vertex of the fœtus to present. The probability of this will be increased by the irregular contractions of the uterus, apt to be excited by parts of the fœtus pressing unequally upon its walls. For example, in extreme lateral obliquity, the breech may press strongly upon one side of the fundus; contraction taking place here will drive the head further off the brim on to the edge, where if it find a *point d'appui*, it will rotate on its transverse axis, producing forehead or face presentation, and, as a further stage, favoring the descent of the shoulder. Wigand pointed out how a too loose and shifting relation of the uterus to the pelvis disposes to cross-birth. In this condition it is observed that the head is placed now in one spot, now in another, and then not felt at all. Wigand[1] further says that any obliquity of the uterus exceeding an angle of 25° is unfavorable; and that even a lesser obliquity, with excess of liquor amnii or a small child, is likely to cause the presenting head to be displaced and to bring a shoulder into the brim, especially if strong pains or bearing-down efforts be made early in labor. Illustrating and enforcing this theory, he showed that the os uteri might be brought down over the centre of the brim by internal pulling upon the os, combined with external pressure upon the fundus in the opposite direction, thus putting in practice the principle of bipolar turning by acting simultaneously upon the two poles of the uterus.

The attachment of the placenta to the lower segment of the uterus is, as Levret has clearly shown, a cause of malposition by forming an inclined plane, which tends to throw the fœtal head out of the pelvic axis across the brim. Hence the frequency of cross-birth and of funis presentation in cases of partial placenta prævia. But, as we have shown, there are numerous cases in which the placenta dips into the lower zone, growing downwards from the posterior and lateral walls of the uterus, without leading to hemorrhage, and thus not suspected to be cases of placenta prævia, which, nevertheless, form an inclined plane behind or on one side, and thus produce malposition.

Want of tone in the uterus, which implies inability to preserve its elliptical form, and a tendency to fall into rotundity, a form which especially favors malposition. Scanzoni says laxity of the uterus is a chief cause. As soon as contraction begins the uterus tends to resume its ovoid form.

Irregular or partial contractions of the uterus cause malposition. Naegele insisted upon this. He found that in some cases malposition was averted by allaying spasm. Heyerdahl says contractions of the uterus are a chief factor, and these are often caused by palpations. This no doubt accounts for a large proportion of the changes of position encountered by the too industrious German observers. They produce the changes they observe.

Credé, Hecker, Valenta, Gassner, Heyerdahl, Schultze, found change of position even more frequent than other observers. Valenta[2] examined 363 multiparæ and 325 primiparæ in the later months of pregnancy. He found that a change of position took place in 42 per cent. Change was more frequent in multiparæ, and in these in proportion to the number of pregnancies. Circumvolutions of the cord, so often observed, are produced by changes of position, and so bear evidence to the correctness of the proposition. On the other hand, shortness of the cord, or entanglement of the cord round a limb, may, by giving a short tether, lead to malposition.

[1] Die Geburt des Menschen, 1820, vol. ii. p. 137.
[2] Monatsschr. für Geburtskunde, 1866.

The *shape of the uterus* may dispose to malposition. Thus, excessive w
of the body and fundus may favor transverse or oblique position of the c
Bocker[1] showed that in many cases at least of excessive breadth of the ut
the essential condition was the persistence of a minor degree of the prim
bicornute state. In this condition the fundus is comparatively depr
whilst either horn bulging out expands it in width. In this way the
axis of the uterus is relatively shortened.

The development of the fœtus in the later months may, as Hoening po
out (Scanzoni's "Beiträge," 1870), be an important factor. A large
cannot so easily change position. The cranial presentation has the gr
stability. A fourth cranial changes to a first, and a third to a second
the cranial rarely changes to a breech. Cranial and breech presenta
are most stable in primiparæ; oblique presentations in pluriparæ.

Premature and dead children are especially prone to present transve
We have seen that a principal factor in maintaining or regaining erect
tion depends upon the resiliency of the child's body, a vital property.
its death this resiliency is soon lost. Then the body is easily compr
loses its ovoid shape, and, yielding to the concentric pressure of the u
becomes doubled up or "balled." This happens mainly after the esc
the liquor amnii, and is a frequent sequence upon oblique presenta
occurring during the child's life.

Monsters also are especially prone to malposition. Wanting in some n
property of shape, size, or resiliency, they easily assume irregular posi

Deformity of the pelvis or lumbar vertebræ is often a powerful factor.
comparative frequency of transverse presentations in cases of deformed
is certainly greater than where the pelvis is well formed. If we may
our own experience, however, we should say that *slight* deformity has
influence in causing malposition than extreme deformity. In the
case, malpositions are rarely observed. In marked deformity the head c
enter the brim, but floats free above it, encountering equal obstructi
every point, and is therefore not affected by hitching on the edge a
point.

The influence of external forces may, with or without the concurren
the conditions above described, be a determining cause of malposition.
is felt in the action of pressure applied to the uterus through the abdo
walls. The dress of a woman at the end of pregnancy is a matter of no
moment. The pressure of a rigid busk of wood or steel upon the fun
the uterus, modified by the various movements of the body, may flatt
the fundus, thus reducing the longitudinal diameter of the uterus; or i
push the uterus further to one side, causing or increasing obliquity. I
at the same time press directly upon the breech, and thus tend to gi
fœtus an oblique position, throwing the head out of the pelvic brim.
paræ should dress on the very opposite principle. They should discar
busk and wear an abdominal belt which supports the fundus of the
from below upwards.

A condition, to which adequate attention has not, we think, been d
is the pouch-like disposition of the lower segment of the uterus as a pre
tive against malposition. In primiparæ, the head is lodged in this pou
such a manner that, even without the support of the pelvic brim, it c
well rise out of it. This disposition is impaired in multiparæ, and
their increased liability to malposition.

It is interesting to observe that the general tendency of changes of po
is towards those which are most propitious. Thus, cranial positions are

[1] Die Bicornität des Uterus als Ursache der Querlagen, 1875.

ble to change, whereas oblique positions are specially liable to change. ese mostly pass into the long axis by spontaneous version. This is but other expression of the continuing influence of the law of accommodation tween uterus and fœtus, or of the operation of those factors which deter- ine the ordinary position of the fœtus.

Self-version is a very frequent resort of Nature. In some cases several anges of position have been observed in the same patient. P. Müller relates case in which within five days a complete version was effected six times. sterlé gives[1] abundant evidence to the same effect.

The Powers of Nature in Dealing with Unfavorable Positions of the Fœtus.

It is useful here to call to mind those minor deviations from the typical ormal position in which the long axis of the child's body still maintains pproximate coincidence with the axis of the pelvic brim. With some addi- onal difficulty, Nature is in most of these cases able to effect delivery with- it materially modifying the position. Forehead and face positions have een described, and the modes in which Nature deals with them. Difficult reech positions will be especially considered hereafter.

From the time of Hippocrates downwards, who compared the child *in utero* an olive in a narrow-mouthed bottle, it has been known that the child ould hardly be born if its long axis lay across the pelvis. But before the me of Denman, it was not clearly understood that a correction of the posi- on, or a restitution of the child's long axis to adequate coincidence with the xis of the pelvic brim, could be brought about by the spontaneous operations Nature. And observations of this interesting natural phenomenon are so re that there are men, even at the present day, who fail to realize the ccuracy of Denman's description. This description contains the pith of the hole question. It is right to quote it: "In some cases . . . . the shoulder so far advanced into the pelvis, and the action of the uterus is at the same me so strong, that it is impossible to raise or move the child. . . . This im- ossibility of moving the child had, to the apprehension of writers and prac- tioners, left the woman without any hope of relief. But in a case of this ind which occurred to me about twenty years ago, I was so fortunate as to bserve that it was not in my power to pass my hand into the uterus . . . . hat, by the mere effect of the action of the uterus, an evolution took place, nd the child was expelled by the breech. . . . The cases in which this has appened are now become so numerous, and supported, not only by many xamples in my own practice, but established by such unexceptionable au- ority in the practice of others, that there is no longer any room to doubt the probability of its happening more than there is of the most acknowl- dged fact in midwifery. As to the manner in which this evolution takes lace, I presume that, after the long-continued action of the uterus, the ody of the child is brought into such a compacted state as to receive the ull force of every returning pain. The body, in its doubled state, being o large to pass through the pelvis, and the uterus pressing upon its inferior xtremities, which are the only parts capable of being moved, they are radually forced lower, making room as they are pressed down for the re- eption of some other part into the cavity of the uterus which they have vacuated, till the body turning as it were upon its own axis, the breech of he child is expelled, as in an original presentation of that part. I believe hat a child of the common size, living or but lately dead, in such a state as possess some degree of resilition, is the best calculated for expulsion in

[1] "Sur rivolgimento," Annali Univ. di Medicina, 1859.

this manner. Premature or very small children have often been expelled in doubled state, whatever might be the original presentation; but this is a different case from that we are now describing."

In this passage Denman plainly sketched out the two principal methods by which Nature deals with transverse presentations of the fœtus. These are now known (1) as spontaneous version, or rectification of the presentation; (2) spontaneous evolution, or expulsion of the fœtus by "balling" or doubling-up of the fœtus.

Let us study these two natural processes more closely, since in them we find the key to rational methods of treatment when Nature fails in her intent.

The first process is called "versio spontanea," "version spontanée," "Selbstwendung." On the other hand, the term "spontaneous evolution" or "expulsion" is rightly applied to that process by which the child is driven through the pelvis doubled up, the presenting shoulder or arm retaining its position all through.

The only mistake Denman made was in using the term "evolution" instead of "version."

1. Spontaneous Version or Rectification.

Labor with shoulder presentation must obey the same laws as labor with head presentation. The difference lies in the altered relation or equilibrium of the ordinary factors of labor. The factors remain.

Shoulder presentations may be *primitive* or *secondary*. The *primitive* exist before labor has set in, and are almost necessarily associated with

FIG. 146.

SHOWING SECOND STAGE IN PRODUCTION OF SHOULDER PRESENTATION.

obliquity of the uterus. The *secondary* are produced during the initiatory stage of labor, under conditions which lead to the deflection of the head from the pelvic brim when it is made to move under the influence of force applied to the breech or trunk.

Spontaneous version must be distinguished from *spontaneous evolution* or *expulsion*. "Version" is the proper term to express the restoration of a

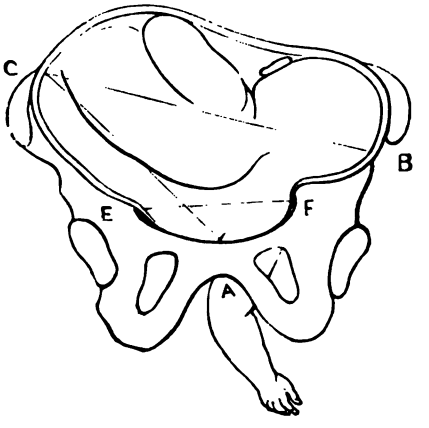
mal position favorable to delivery—that is, a position in which the long s of the child is brought into coincidence, or nearly so, with the axis of uterus and with the axis of the pelvis. Thus the relative position of the ld is changed.

There are *two varieties of spontaneous version*, one in which the head is sub-uted for the shoulder, the other in which the breech is substituted for the ulder. These varieties of spontaneous version are the key to two corre-nding varieties of artificial version.

These processes may now be described.

In Fig. 146 is a diagrammatic scheme representing the second stage in the duction of a shoulder presentation out of one of the head.

FIG. 147.



SHOWING FURTHER STAGE IN PRODUCTION OF SHOULDER PRESENTATION.
A B C. Were formed by child. A. Apex; B C. Base; E F. Transverse diameter of pelvic brim.

ig. 147 represents the next stage in the production of shoulder presenta-: the breech is further depressed; the axis of child and uterus presents rther divergence from the axis of the pelvis; the head has lodged in the iliac fossa.

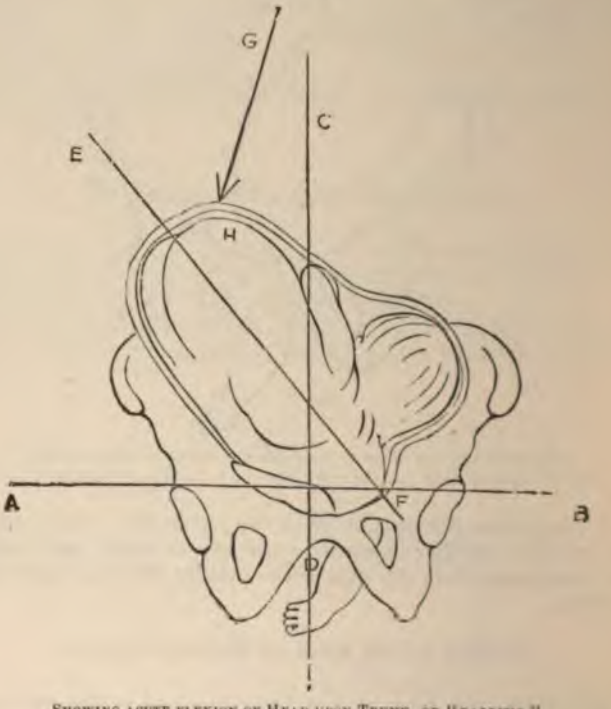
Version by the Head, or Cephalic Version.

n the first stage, the long axis of the child and of the uterus stands ob-ely with reference to the pelvic axis. At the beginning it is not very ant from the perpendicular of the brim. It is a serious error to regard se presentations as absolutely cross or transverse. It is only in the ad-ced stage of labor with shoulder presentation, when the liquor amnii has n long drained off, when the uterus has been contracting forcibly, driving shoulder deeply into the pelvis, that the child can truly be said to lie oss the pelvis. Diagrams copied from text-book into text-book have ded to fix this false idea in the obstetric mind. Yet the great masters ar distinct evidence to the contrary. Wigand insists that transverse posi-ns are rare. Esterlé and Lazzati say the same, and maintain that the lique position is favorable to spontaneous version. We venture to say at, except in cases of dead, monstrous, or small children, or with loss of ce of the uterus through excess of liquor amnii, a true cross-birth, such is commonly pictured and generally imagined, does not exist at the com-encement of labor. It would be better to discard the terms "cross-birth"

and "transverse presentation" altogether, and to speak of shoulder or oblique presentations only. In the shoulder presentation an oblique position of the child may become transverse in the course of labor; but the presentation is not transverse *ab initio*. The failure to realize this fact has been a main cause of the errors that prevail in the doctrine and practice of Turning.

In diagram (Fig. 148) the child and the uterus E F stand obliquely, at an angle of about 15° or 20°, to a perpendicular C D, drawn upon the plane A B of the pelvic brim. The child's head is nearly in a straight line with its spine. It stands partly over the brim, and partly projecting beyond into the left iliac fossa. This is the *first act*. This act may pass back into natural

FIG. 148.



SHOWING ACUTE FLEXION OF HEAD UPON TRUNK, OR "BALLING."

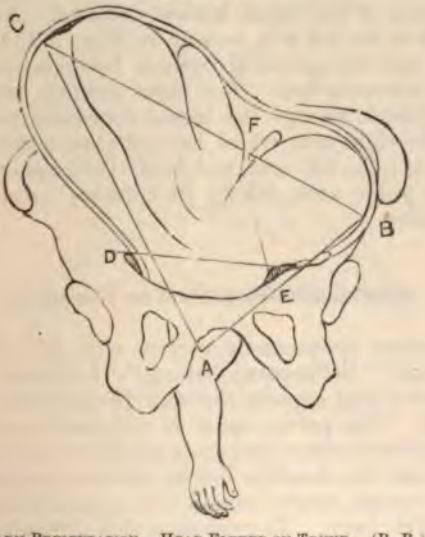
head labor. Wigand, Jörg, and d'Outrepont say this position is common, and that the effect of the first uterine contractions is usually to bring the long axis of the uterus and of the child into due relation with the pelvic brim. This phenomenon is, in fact, a form of self-turning or natural rectification.

VERSION BY THE BREECH.—If this attempt at rectification fail, then we have the transition into shoulder presentation. The shoulder or arm cannot come down into the pelvis until the *second act*, a movement of flexion of the head upon the trunk, takes place. This happens in the following manner: The muscles of the fundus uteri contracting, aided or not by the downward pressure of the abdominal muscles and diaphragm, bring a force acting primarily upon the breech, which lies at the fundus. This force will strike with greatest effect upon the left or uppermost side of the breech, at an angle with the long axis of uterus and child. The line G H represents the direction of

this force. The result is that the breech descends. If the cavity of the uterus were as broad as long—that is, if it were a flattened sphere or short cylinder—the child's long axis, formed by spine and head, might preserve its rectilinear character; and as the breech descended, the head would simply rise on the opposite side until it came round to the spot abandoned by the breech, performing, in fact, complete version. But the uterus is narrower from side to side than from top to bottom. The head will find great difficulty in rising; it therefore bends upon the neck. The shoulder pertaining to the trunk is kept at the lowest point in a line with it. The head is thrown more into the iliac fossa, where it rests for a while. Fig. 148 represents this second position of the child. A B is the plane of the brim; C D the perpendicular to the plane, representing the axis of entry to the pelvis; E F is the axis of the child's trunk; and G H shows the direction of the downward force, which now strikes the uterus and child at a greater angle with the perpendicular.

Now the arm will commonly be driven down, and the hand may appear externally. The observation of the hand will tell the position of the child. The back of the hand looks forwards, the palm looks backwards, the thumb to the left. All this tells plainly that the head is in the left iliac fossa, where, indeed, it may be discovered by palpation, and that the child's back is turned forwards to the mother's abdomen. The right scapula will be close behind

FIG. 149.



ARM PRESENTATION. HEAD FLEXED ON TRUNK. (R. B.)
E F. The line which bisects the wedge A B C.

the symphysis pubis; the acromion and right side of the neck will rest upon the left edge of the pelvic brim; and the right axilla and right side of the chest will rest upon the right edge of the pelvic brim; whilst the belly and legs of the child, turned towards the mother's spine, will occupy the posterior part of the uterus.

At this stage, even after the liquor amnii has been partly drained off, spontaneous version may still be effected. The process described as the second act still continuing, the breech is driven lower, the trunk bends upon its side, the curve thus assumed by the long axis carries on the propelling

force across the pelvic brim, the head tends to rise still higher in the left iliac fossa, the presenting shoulder and prolapsed arm are drawn upwards a little out of the pelvis. This *third act*, one marked by increased lateral flexion of the child's body, and of movement across the pelvic brim, is represented in Fig. 149.

If spontaneous version is to be completed, the *fourth act* succeeds. The breech, being the most movable part, receiving the main impact of the driving force, and the trunk being capable of bending upon itself, partly on its side, partly on its abdomen, is driven lower and lower; the right shoulder being forced well over to the left side of the brim, and the head being fairly lodged in the upper part of the iliac fossa, the brim is comparatively free for the reception of the trunk. This enters in the following manner: The right hip comes first into the brim; it is forced lower and is followed by the breech. As soon as the breech enters the pelvis—that is, as soon as it gets below the sacral promontory—a *movement of rotation* takes place, analogous to the rotation which the head takes in head-labor. There is most room in the sacral hollow, and there the breech will turn, following Barnes's curve. This turn of the trunk brings the body from the transverse position it occupied above the brim to one approaching the antero-posterior, and commonly the head yields somewhat to the altered direction of the spine by coming more forward.

When this rotation movement is effected, or rather simultaneously with it, a *movement of descent or progress* in an arc of a circle round the pubic centre goes on. The flexion of the spine is now reversed. Above the brim the trunk was concave on its left side, as seen in Figs. 146, 147, 148. When the breech has dipped into the pelvis, the trunk becomes concave on its right side. The breech descends first. The right ischium presents at the vulva. Then the whole breech sweeps the sacral concavity and perineum. The trunk follows. The right arm, which has not always risen completely out of the way, comes next; the left arm, and lastly the head, the right side of the occiput under the pubic arch taking its rotation movement and its moment in Carus's curve.

Spontaneous Expulsion or Evolution.

Let us now contrast spontaneous version with spontaneous evolution. "evolutio spontanea," "Selbstentwickelung," "évolution spontanée." The cause of the difficulty that opposes delivery in shoulder presentation must be first understood. The pelvic canal is too small to permit a full-sized living child to pass freely when its long axis lies across the inlet. On looking at Fig. 149 we see the shoulder driven into the pelvis, forming the apex A of a triangle or wedge, whose base B C is considerably longer than any diameter of the pelvic brim. To overcome this difficulty, Nature struggles to shorten the base B C. To a certain extent she generally succeeds, and occasionally she succeeds completely.

When the liquor amnii has escaped, the uterus contracts concentrically, tending to shorten all its diameters, especially the transverse diameter. The axis formed by the trunk and head of the child, which go to make up the resisting base of the triangle, is flexible; therefore B and C are brought nearer to each other. This process we may call the "*balling of the child*." When the utmost approximation has been attained in this manner, we still have the entire thickness of the head, equal to four inches and only slightly compressible, plus the thickness of the body, which, after all possible gain by compression is effected, is equal to at least two inches more. The sum

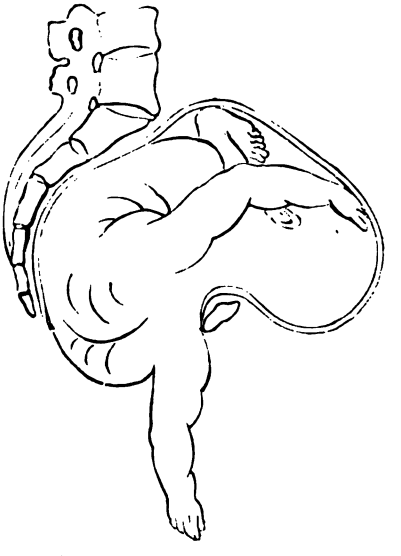
will exceed by an inch or more the available space in the brim. Or, taking by circumferences, which is the more exact method, we should find that the circumference of the fœtal ball exceeds that of the brim, 14.60 inches, by three inches or more.

As a general rule, it may be stated that no part of the child, except a leg or an arm, can traverse the pelvis along with the head, and even this not without difficulty. The head alone is quite large enough to fill the pelvis. One result of the great compression exerted by the concentric contraction of the uterus is to cause such compression upon the chest, abdomen, head, and neck of the child, and so to compress the placenta and cord, that the child is asphyxiated and killed. It is simply squeezed to death. The contraction of the uterus, although evincing returns of spasmodic violence, rarely remits enough to allow of the restoration of the placental circulation at recurring intervals. The death of the child, leading to loss of resiliency, will, after sufficient time, admit of a much further degree of compression or "balling," and then possibly the child may be so doubled up and moulded that it may enter the pelvis.

One condition, therefore, of spontaneous evolution is the death of the child. If not already dead at the commencement, it will almost certainly, if of medium size or larger, be killed in the course of the process. Other conditions are, a child below the normal size, monsters defective in resiliency and in parts to which the normal physical properties are due.

Herein lies a great distinction between version and evolution. A living child is favorable to version, a dead one to evolution.

FIG. 150.



EVOLUTION IN PROGRESS. (R. B.)

The process of spontaneous evolution, also described by Denman and others before him, was afterwards explained by Douglas, who put forward his explanation as a correction of that of Denman under the erroneous impression that Denman's description was not based upon correct observation and interpretation. Douglas was right as to the affirmation of spontaneous evolution, and wrong as to negation of spontaneous version. Denman was

not only right as to spontaneous version, but also as to spontaneous evolution. Both processes are now well understood. Kleinwächter gives an excellent illustration of spontaneous evolution in process in a frozen corpse. We select a similar illustration from Chiara.

Spontaneous evolution from the first position proceeds as follows: At first we have the oblique position of fœtus and uterus represented in Fig. 146. Secondly, strong flexion of the head upon the trunk and descent of the shoulder into the pelvis, Fig. 149; the head is in one iliac fossa, the breech in or approaching the other. At this stage, commonly, the membranes burst, and the arm falls into the vagina, the hand appearing externally. Thirdly, increased descent of the shoulder and protrusion of the forearm. If the child is alive at this stage, the protruding hand and arm become greatly swollen and cyanosed, livid, from the pressure upon the veins in the axilla against the pelvic wall. This swelling, then, is evidence of life. Another correlated fact is that at this stage the cord frequently comes down and may be felt pulsating. It is apt to be washed down by the rush of liquor amnii, if the membranes burst before the shoulder and chest fill the pelvic brim. The body then doubling or balling under compression, the shoulder jammed against the symphysis, the lower side of the chest bulges more and more, and presents under the pubic arch. The bent trunk is forced lower into the pelvis, is followed by the breech, which finds accommodation in the sacral hollow. This brings about a change in the relation of the child to the pelvic diameter. From transverse, as above the brim, the child now approaches the conjugate diameters; the head comes more over the symphysis. Then, lastly, comes the *movement in a circle* of the body round the fixed shoulder. The side of the trunk and of the breech sweep the concavity of the sacrum and the perineum; the legs follow. When the whole trunk is born, the movement of restitution is effected, the back turning forwards, the belly backwards. The head escapes from its fixed position above the symphysis; the chin turns downwards; the occiput looks upwards to the fundus uteri; the nucha is turned to the right foramen ovale. The head enters in the left oblique diameter; it takes the rotation movement in the pelvis, the occiput coming under the pubic arch. Then the movement in Carus's curve is executed; the chin first appears, followed by mouth, nose, and forehead, which successively sweep the perineum. The occiput, which had been applied to the symphysis, comes last. The left arm usually escapes soon after the emergence of the trunk. So strict is the subjection throughout this process to the laws which govern the mechanism of ordinary labor, that Lazzati does not hesitate to describe spontaneous evolution[1] as the natural delivery by the shoulder.

The lower segment of the uterus expands slowly, continues rigid; the vagina becomes tumid, congested; the vulva presents similar characters. The perineum is put upon the stretch, and is likely to undergo laceration.

The case described is the most common form of spontaneous evolution. It is the type of the rest. Keeping its mechanism well in mind, there will be little difficulty in tracing the course of spontaneous evolution when the child presents in any other position.

Such, in brief, is the description of spontaneous evolution. Were it more often justifiable to wait and watch the efforts of Nature, we should probably not seldom enjoy opportunities of observing it; but the well-founded fear lest Nature should break down disastrously impels us to bear assistance.

Spontaneous evolution may be accomplished by the *head traversing the pelvis first*. The case is, indeed, rare, but the process and the condition

[1] Del parto per la spalla, 1867.

under which it occurs deserve attention. The essential idea of spontaneous evolution is that the presenting shoulder remains fixed, or at least should not rise up out of the pelvis into the uterus. Therefore, if the head comes down, it must do so along with the prolapsed arm. This simultaneous transit of the head, arm, and chest can hardly take place unless the child is small. If the child is very small, the difficulty is not great. If the child be moderately large, it will be far more likely to be born according to the process above

FIG. 151.

CHIBARA'S FROZEN SECTION. SHOULDER PRESENTATION IN PROCESS OF SPONTANEOUS EVOLUTION, *conduplicato corpore.*

described and figured. But some cases of head-first deliveries have been observed. Pézerat relates[1] a case that seems free from ambiguity. The child was large, the shoulder presenting. A violent pain drove the head down. Fichel de Flichy[2] gives two cases. Ballochi relates one.[3] Robert Barnes has seen an instance of the kind. Lazzati and Monteggia held that in such cases the descent of the head was the result of traction upon the

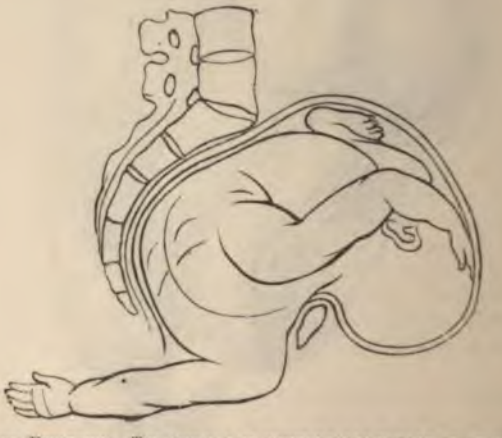
[1] Journal Complémentaire, t. xxix.
[2] Observations Medico-Chirurgicales.
[3] Manuale completo di Obstetricia, 1859.

protruding arm. Fielding Ould relates the following: He was called to assist a midwife who had been pulling at the child's arm, which came along with the head. The head was so far advanced that it could not be put back in order to come at the feet. However, after an hour of excessive toil, he brought forth a living child with a depression of the parietal and temporal bones proportional to the thickness of the arm. Next morning the bones had recovered. Mother and child did well.

What are the conditions required for the execution of spontaneous version? We are now in possession of at least some of the facts necessary to enable us to answer this question. It is probable, however, that some of the conditions are not yet understood. Certain it is that we are hardly yet in a position to predicate in any given case of shoulder presentation, seen at an early stage, that spontaneous version will take place, as we might be if all those conditions were known and recognizable. They would be more familiar if the law to turn were not laid down in such imperative terms; if the dread of evil as the consequence of neglect of that law were not so overwhelming. For if Nature be always superseded, if the physician always resort to artificial turning as soon as he detects a shoulder presenting, how can he obtain sufficient opportunities for discovering the resources of Nature and how she acts in turning them to account?

The principal conditions, however, seem to be: 1. *A live child*, or one so recently dead that the tone or resiliency of its spine is still perfect. 2. A certain degree of *mobility of the child in utero*. 3. Strong action of the uterus

FIG. 152.



PROCESS OF SPONTANEOUS EVOLUTION. THE ARM IS LAID HORIZONTALLY TO SAVE SPACE ON THE PAGE. (B. S.)

and auxiliary muscles. A roomy pelvis does not appear to be especially necessary. The retention of some amount of liquor amnii may facilitate mobility. It most frequently takes place at the beginning of the dilatation-stage, when the fœtus is freely movable. It is effected by the restitution action of the uterus.

Spontaneous version is not likely to take place when the shoulder has been driven down in a point with a part of the chest-wall low in the pelvis, and the uterus is strongly grasping the fœtus in every part, bending its long axis by approximating the head and breech. It is not likely to take place when the head has advanced towards a position above the symphysis pubis, indicating that the movement of rotation has advanced. Several observers,

ever, have witnessed self-turning when the arm has protruded. Spiegel- has seen it twice. But the practical question will arise: Is spontaneous ion so likely ever to occur that we shall be justified in trusting to Nature? ple experience justifies an answer in the affirmative. But the great n taught by the observation of the phenomena of version is this: If ure can by her unaided powers accomplish this most desirable end, we by careful study and appropriate manipulation assist her in the task. shall be the better ministers to Nature in her difficulties, as we are the er and humbler interpreters of her ways. "*Natura enim non nisi parendo tur.*"

he application of this principle and of the preceding study will be dis- ed when we have to treat of the operation of Turning.

Diagnosis, Course, and Treatment—Dangers to Mother and Child.

he *diagnosis*, consisting mainly in recognizing the malposition, resolves f nearly into that of the presentation. The question of prognosis—that f estimating the probability of the case being concluded by Nature's ations, spontaneous version, or spontaneous expulsion—must be governed he considerations already set forth, and by the conditions of the individual

he *treatment* may be very important. It consists obviously in aiding ure in the task she is engaged in. In cases favorable to probable cephalic ion, the physician takes note of the obliquity of the uterus and assists in ifying it. For example, if, as is commonly the case, the fundus is in- ed to the right, he applies pressure to the fundus on the right side, cting it towards the median line, whilst at the same time, by the palm of other hand applied to the opposite or pelvic end of the uterus, he pushes to the middle line. Thus gentle, steady pressure applied simultaneously oth poles of the uterus, the axis of the uterus and of the child is brought due relation with that of the pelvis, and the head is carried to its proper ce over the brim. Or the bipolar principle may be applied in another —namely, by pulling down the cervix uteri from within, by hooking the finger into the os uteri, whilst pressure is exerted on the fundus externally ards the median line. If, when due relation is attained, the membranes ruptured, the restitution force of the uterus will aid in securing the head he brim. If this be found doubtful, the forceps should be applied. The rse of the labor is then greatly under the command of the physician. e posture to be observed by the woman should be that which favors gravi- ion of the fundus uteri towards the median line.

This question and the cognate one, how to aid spontaneous version by the ech, will be further discussed when describing "Versions." If obliquity the uterus and moderate deviation of the head to the side of the brim be served before the advent of labor, things may be brought into due relation similar external bipolar manœuvres, and secured there by judicious pad- g at the fundus, and in the iliac fossa maintained by a roller. This has en practised successfully by Flamant, Osiander, Wigand, d'Outrepont, rselves, and others.

How to aid spontaneous evolution will be described when treating of ver- n under "Dystocia."

Danger to Mother and Child.—The spontaneous version is favorable recovery of mother and child. The process, being, in fact, a return to e conditions of natural labor, is therefore propitious to both. This applies pecially to cephalic version. The risk attending breech version is also

small to the mother, but the risk to the child is likely to be the same as that encountered in ordinary breech labors.

The danger attending spontaneous evolution is serious. As we have seen, the process commonly postulates a dead or immature child to begin with, or its destruction during its execution. A very small child might pass alive through a roomy parturient canal. Simon[1] says that 14 out of 125 children survived, and in some of these the child was well developed. The danger to the mother exceeds that of ordinary labor. She has to run the gauntlet of rupture of the uterus, of exhaustion, of injury to the bladder, of overwrought nervous and vascular tension at remote points—in short, all the dangers of dystocia arising during the labor and consequent upon it.

It is not easy to state these numerically. The number of cases uncomplicated by accident and by treatment are too limited to admit of those seemingly precise, but really most deceptive, constructions called statistical statements. But Simon notes only 3 maternal deaths out of 125.

Presentation of the Limbs along with the Head.—We have already said that, as a general rule, the head is large enough to fill the pelvis by itself. It does not readily tolerate any other part in company. But it occasionally happens that a hand, or even an arm, may descend alongside the presenting head. Such cases may be said to be "missed shoulder presentations." A little more descent of the arm or at a little earlier period, and the head might be deflected out of the brim, and the shoulder might take its place.

It is not a very uncommon event, however, for a hand to come down by the side of the head partly engaged in the brim. Generally, as soon as the head descends so low as to get fixed in the brim, the hand or arm, meeting more resistance from the lower segment of the uterus and the side of the pelvis, recedes, and the head then proceeds alone.

When the arm is prolapsed, this is generally due to imperfect filling of the lower segment of the uterus and of the pelvic brim by the head; as happens when the position of the uterus is oblique, or the head is small, or the shape of the brim is irregular, as when it is reniform. Premature labor and death of the fœtus are favoring conditions. Under such conditions the arm is likely to be washed down when the liquor amnii escapes with a rush. Under ordinary proportions, it is not a very rare thing to see the hand, and even a part of the forearm, come through the outlet alongside of the head. But there may be considerable delay and difficulty if the arm descends low in the anterior wall of the pelvis. Such a relation may impede the rotation of the head, and lead to great bruising of the arm. The least troublesome relation is when the arm is placed in the hinder side of the pelvis; it then finds room in the space on the right or left of the promontory, and may not seriously interfere with the course of labor.

The *treatment* falls within the scope of the operations for dystocia, and will be described in the section on "Version." We are in this place concerned with the more strictly physiological cases.

Complicated Presentations.

Prolapse of the Umbilical Cord is a frequent complication of oblique and breech presentations, of placenta prævia, premature labor, excess of liquor amnii, indeed of all labors in which the lower segment of the uterus below Bandl's ring and the brim of the pelvis is imperfectly filled by the

[1] Die Selbstentwickelung, 1867.

presenting part of the child. This subject also will be more fully described in the section on "Version."

PRESENTATION OF THE PLACENTA.—This is described under "Hemorrhage."

PRESENTATION OF A POLYPUS OR TUMOR.—This will be described under "Dystocia."

DORSAL DISPLACEMENT OF AN ARM also falls under "Dystocia."

Twins.

The history of twin gestation has been partly drawn in the chapter on the "Physiology of Gestation." We refer to this section (see p. 204) as an introduction to what follows on the clinical aspects of labor with twins.

In many cases the labor is premature, coming in the eighth or ninth month. The combined weight of the two fœtuses, and therefore of the space they occupy, will commonly exceed that of a single fœtus, even of a more advanced gestation. Thus taking the weight of a mature single fœtus at term to be nine pounds, the combined weight of twins at the end of eight months, may be twelve pounds or more. Add to this excess of weight and bulk of the fœtal element, the increased quantity of liquor amnii, the two placentas, and the larger uterus, and it is not surprising that tolerance of the gestation is exhausted at an earlier period than in the ordinary course of single gestation. Perhaps also, under the double stimulus, the vascular and nervous tension is greater, and so the explosion of labor is precipitated. One factor determining labor is, no doubt, the distention of the uterus, and the limit of distensibility is sooner reached in twin gestation. The account given (see p. 204) of the disposition of the fœtuses in utero supplies the clew to the character of the labor. Thus, when the fœtuses are enclosed each in its own fruit-sac, the cords and limbs are usually preserved from mutual entanglement. Then the children will be born successively without difficulty.

There are two chief dispositions of the children: 1. In this case both the fœtuses are disposed head lowermost, but on a different level. 2. The fœtuses are reversed—that is, one occupies the lower segment of the uterus, its head lowermost over the pelvic brim; the other fits itself to the uterus and its fellow by taking the opposite posture—that is breech downwards, head at fundus uteri. Each fœtus is in its own sac; one lower than the other.

THE POSITION OF THE FŒTUSES AT LABOR.—Spiegelberg, summing up 1138 twin labors analyzed by Kleinwächter and Reuss, found that both presented by the head in 558 instances, or very nearly one-half; that one presented by the head, the other by the breech, 361 times, or nearly one-third; that both presented by the breech 98 times; one by head and one transversely, 71 times; one breech and one transverse, 46 times; both transversely, 4 times.

Thus, of 2276 children, the head presented in 1548, the breech in 603, and there were 125 transverse presentations.

It is thus seen that although head presentations predominate, the proportion of breech and transverse presentations greatly exceeds what is observed in single births.

In both cases, one ovum presents at the cervix uteri and engages in the brim of the pelvis at a time. Indeed, under the law of accommodation, one fœtus will necessarily push the other aside during gestation, or at the commencement of labor. Thus, at the beginning twins may not be suspected. The membranes and a head present in the ordinary way. The dilatation period is often more tedious. The force has to be transmitted to the pre-

senting bag of membranes through the other bag. Force is therefore wasted. Besides this, the uterus is over-distended and its contractile power is impaired. When the presenting bag is ruptured, and the liquor amnii has wholly or partially escaped, there may still, for the reasons stated, be some delay in the expulsive stage; but not seldom the uterus acts vigorously and the first child is born quickly. When this is delivered, its cord should be tied.

Course of Labor with Twins.—Taking the case in which the fœtuses are disposed head down, we find that one presents at a time. The membranes burst, the head engages in the pelvis much as in single labor, and the child progresses through to birth. It sometimes happens that the second child follows very quickly, so that there is no time or occasion to consider diagnosis or treatment. But sometimes the first child is delivered slowly.

Fig. 153.

Showing one disposition of twins. (Ramsbotham.)

Occasionally its placenta follows. If it should not do so at once, it is held to be good practice to tie its cord, separate the child, and wait a while. The reason for tying the cord is the possibility of anastomosis between the placentas of the two fœtuses, so that if we divided one cord without tying it, blood might be drained off from the placenta, and the child still in utero and dependent upon the placental circulation might be destroyed. This possibility, slender as it is, must be borne in mind.

An interval of repose follows the expulsion of the first child. It is observed that the abdomen and the uterus have not shrunk as is usual after single birth; and on palpation the outline of the still large uterus may be felt; the parts of another child may also be made out. Examining internally, a second bag of membranes is felt occupying the dilated cervix uteri, and through it the presenting part of the child; in the case under considera-

it is another head. The passages having been fully dilated or "canal-
' by the first child, it might be expected that the second child would
quickly. It is often so. But occasionally the labor lingers, from ute-
or systemic exhaustion. If not aided, the delivery of the second child
be delayed for several hours. Cases are reported in which the second
has not been born until one, two, three, or more days later.
hen the second child is born, its cord is tied in the usual manner. There
in an interval of repose, to prepare for the placental period. It is not
ible to hurry this stage. But it is especially useful to maintain steady
ire upon the body of the uterus. When the contractile property returns,
ressure should then be concentric—that is, the uterus should be grasped
e two hands, as described by the title of "Expression of the Placenta."
e over-distended uterus rarely contracts so powerfully as to detach and
he placentas as it does in single labor. "Expression," therefore, is
ally called for. In this way the placentas may be detached and
zed out into the bed. In some cases the placentas come separately; in
s, attached in one cake. But it is necessary to be doubly careful so to
ress the uterus from side to side as well as downwards, as to avoid
ng inversion of the organ.
e placentas expelled, steady pressure should still be kept up on the fun-
iteri, at first by the intelligent hand, then by pad and binder. The
ity to hemorrhage in plural labors is greater, from four causes: 1. There
obably a greater volume of circulating blood with increased vascular
on; 2. The area left bare by the double placenta is greatly larger; 3.
uterus is thinner and weaker; 4. The shock of the labor is greater, due
y to the sudden loss of the double burthen. We have seen that Gassner
ates the loss in single labor, made up of child, liquor amnii, placenta,
l, and excretions, at a little more than ten per cent of the body-weight.
the case of twins, the proportional loss to the body-weight is higher.
sudden removal of this mass from the pelvis and abdomen must exer-
corresponding impression upon the nervous and vascular systems.
far labor with twins follows the ordinary course of single labor, the
ence being that one ovum presents first and that another follows. Such
or falls under "Eutocia." But things do not always proceed so smoothly.
fœtuses may obstruct each other in the labor, and give rise to serious
s of "Dystocia," requiring operative aid to release them and to effect
ery. These complications and the treatment will be described in con-
on with the appropriate operations.

Triplets.

bor with triplets differs mainly from labor with twins in being likely to
ven more premature. The children may follow each other at long inter-
but sometimes they succeed rapidly, and it is even possible for two of
to engage in the pelvis at the same time. The placentas may be dis-
. In one case observed by ourselves three placentas came away quite
rate from each other. They may, however, be united at their margins.
acenta may present after the birth of one child, and come away before
next child engages in the pelvis. Entanglement may occur as in twins,
the children being generally smaller, great difficulty rarely occurs from
cause. The risk of hemorrhage is probably greater than in twin-labor,
corresponding care is required in preventing or arresting it.

CHAPTER XIX.

ACCIDENTS OCCURRING DURING AND FOLLOWING UPON LABOR. THE HEMORRHAGES, INCLUDING THE HEMORRHAGES OF GESTATION: SO-CALLED "ACCIDENTAL HEMORRHAGE;" PLACENTA PRÆVIA; POST-PARTUM HEMORRHAGE; SECONDARY OR PUERPERAL HEMORRHAGE; THROMBUS OR HÆMATOCELE.

DURING labor and soon after it certain accidents may arise. The principal accidents that occur during labor are:

A. Hemorrhage, including thrombus or hæmatoma.

B. Lesions of the parturient canal, as ruptures, lacerations, bruisings of the uterus, vagina, and perineum; sloughing.

C. Fistulæ: vesico-vaginal, recto-vaginal.

D. Inversion; retroflexion; anteflexion of the uterus.

The following accidents, although their cause may be traced back to the labor, come into prominence chiefly at variable times after labor:

E. Inflammation and loosening of the pelvic joints.

F. Subinvolution of the uterus.

G. Various nervous disorders, as paralysis of the uterus, bladder, and intestines. (Puerperal insanity has been described under the "Diseases of Gestation.")

H. Disorders of the circulation and lungs. (These merge into the "Diseases of Puerpery.")

This chapter will comprise the history of

A. HEMORRHAGE.

In order to present a connected and more philosophical account of hemorrhage, we here bring together, into one continuous history, the hemorrhages of gestation, of labor, and of puerpery. The hemorrhages which break out during these successive epochs of the parturient process have one common foundation. It is true that the conditions which lead immediately to the outbreak of hemorrhage in these three epochs, that the clinical history, and the treatment present distinctive characters. Still, the different characters will be the better understood by studying the hemorrhages of parturition in their essential connection, preserving the natural order of historical sequence. So shall we more firmly grasp the general facts and laws of hemorrhage, their physiological evolution, and the principles of treatment.

General Laws and Predisposing Causes of Hemorrhage.

The chief of these are high nervous and vascular tension; hydræmia; the stimulus of ovulation; the developmental attraction of blood to the pelvic vessels.

Although these factors are most active in gestation, some of them are at work in the hemorrhages of the non-gravid state. The hemorrhages of early gestation are strictly analogous to menstruation and menorrhagia. This analogy, if less clearly seen in the hemorrhages of advanced pregnancy, of labor, and of puerpery, may nevertheless be traced. It is a further illustra-

tion of the physiological homology of menstruation and labor already pointed out.

We may first broadly distinguish the hemorrhages as follows:

1. The hemorrhages of gestation
2. The hemorrhages of labor. } are hemorrhages of high tension.
3. The hemorrhages of puerpery are hemorrhages of low tension.

Thus we realize a first distinction.

1. The Hemorrhages of Gestation.

These group themselves clinically into:

A. The hemorrhages of the first three or four months, and

B. The hemorrhages of advanced gestation.

A. The Hemorrhages of Early Gestation.

Many of these are associated as cause and effect with abortion. In tracing the history of abortion we have necessarily referred to these cases. But hemorrhages occur in connection with early pregnancy which do not necessarily affect the attachments of the ovum. It is desirable to point these out in the first place.

Hemorrhages of Early Pregnancy not Entailing Abortion.—Under the high vascular tension and pelvic hyperæmia attending gestation, the gorged mucous membrane of the vaginal portion and cervical canal may permit blood to ooze out in quantity large enough to attract attention, and to give the alarm that abortion is impending. This may occur without any lesion of the mucous membrane. But it is more likely to occur when there is abrasion or loss of the epithelial element. In either case, the hemorrhage is especially prone to break out at a menstrual epoch. Indeed, this is a general law observed in all the hemorrhages of gestation, and, it may be added, of all hemorrhages after labor, and in the non-gravid state. It is the consequence of the increase of vascular and nervous tension at those epochs.

The continuance of hemorrhages of this kind, although the blood escapes from an area outside that properly concerned in the gestation, may still, by attracting an unwonted flux to the uterus generally, lead to such excess of blood-pressure in the uterine vessels as to induce extravasation in the decidua, and thus lead to abortion.

In this event we see an illustration of one of the laws of hemorrhage which has a wide application. The law is this: When hemorrhage sets in from any given point, there quickly follows an attraction of blood towards the point of escape. The blood destined for the system generally is greatly diverted from its equable distribution, and directed in undue force and quantity to the broken point in the circulation. There is, in short, a disorder in the dynamics of the circulation.

One indication, then, in the treatment of all hemorrhages, especially applying to the case in question, is to control this perverted action of the circulation. To accomplish this we seek to lower the nervous and vascular tension, by giving salines, laxatives, and sedatives. Digitalis and the bromides are extremely useful. Lisfranc insisted upon the value of "derivative venesection"—that is, opening a vein in the arm; by setting up a new attraction the current of blood will be diverted from the seat of hemorrhage. At the same time the tension of the vascular system is lowered. Without recommending empirical recourse to this method, we know that in

some cases it has been useful, and it illustrates the law of hemorrhage. At the same time we examine the seat of hemorrhage for indications for local treatment.

But there is another form of local disease, almost always giving rise to hemorrhage, which demands close attention. This is *malignant disease of the cervix uteri*. In cases of this kind, hemorrhages, at times profuse, occur at the menstrual epochs and at uncertain times; copious serous discharge tinged with blood, and often offensive to the smell, being more or less continuous. Pain is not constant. When these discharges are observed, local exploration may reveal the disease by the enlargement of the vaginal portion, induration, an irregular knobby surface, perhaps ulceration. One event is common, the occurrence or increase of bleeding under the examination. But we must point out that all the conditions mentioned may be found, and yet the case may not be one of malignant disease. We have been consulted on cases so suggestive of cancer that immediate resort to amputation of the diseased cervix, or the preliminary induction of labor, has been strongly urged, and in which the subsequent history proved that there was no cancer. The conditions described are sometimes produced under the simple action of gestation upon a cervix which had previously been the seat of chronic follicular inflammation. The glands or follicles of the vaginal portion become the foci of inflammatory action; hyperplasia with induration is set up, and then when the intense hyperæmia of gestation is added, the swelling is greatly increased, the dark purple congestion and abrasion from epithelial shedding enhance the suspicion of malignancy, and the case is set down as cancer. We have seen all these conditions subside quickly after labor, and the cervix return to the pale smooth appearance of health. It will nevertheless sometimes be difficult to differentiate these cases. It might, perhaps, be stated generally that we should not readily admit the presence of cancer unless it had been fairly diagnosed before the gestation, and unless there is evidence in induration and fixing of the cervix by extension to the vaginal roof.

It may be reasonably suspected that some cases published as successful examples of amputation of cancerous cervix during gestation were examples of the simulated cancer described above.

The Course of Gestation Complicated with Cancer.—When things are allowed to take their course, the issue is almost invariably disastrous. The disease is not arrested by gestation, hemorrhage and exhausting discharges recur, and when labor sets in there is imminent danger of laceration of the cervix, which may extend and cause rapid death. If the woman escape this catastrophe, she still has to run the hazard of traumatic hemorrhage, which it may be difficult to restrain even by the actual cautery or by ferric chloride. The next danger is from sloughing of the injured tissues and septicæmia. And if she survive all these dangers, she will probably sink at no distant period from the ordinary progress of the disease, the more quickly from the impaired vital powers consequent on labor and puerpery.

It occasionally happens that the natural development of the inferior segment of the uterus and of the cervix being prevented by the diseased transformation of tissue, labor at term is postponed, and the fœtus perishes. We have seen a deplorable instance of this kind. A woman who had borne several children was, in her last pregnancy, overtaken by malignant disease of the cervix. It was detected when gestation was advanced. The calculated term had been passed, when profuse fetid discharges and septicæmia set in. In this state she came up from the country, moribund. We found the cervix and lower segment brawny, thick, bleeding, and a most fetid

ench; the skull was felt presenting, scalp flaccid, bones loose. She was o far gone to think of Cæsarean section, the more especially as the disease ad so extended that Porro's operation could not have been carried out. s the sole hope of relief from the septicæmia, we removed the macerated etus, after crushing down, to offer the minimum of resistance. The brittle ecrosed tissues of the uterus gave way, and death—not, we believe, much ccelerated by the operation—followed in a few hours.

In other cases the fœtus has died and been retained for some time, sug- esting "protracted gestation" or "missed labor."

TREATMENT.—This will depend upon the nature and extent of the disease. hree classes of cases may be distinguished:

1. Those in which the disease is strictly localized in the vaginal portion, nd coming under observation near the term of gestation. In these the rospect of delivery with safety is good. There is some danger lest the iorbid tissues may rend under the distention of the passing head; but, as a linical fact, the cervix generally dilates fairly.

2. In a second class of cases, the disease still localized and the gestation ot far advanced, it will be best to amputate the diseased portion by the *craseur* or by the galvanic cautery wire. Thus taken early, we may hope o anticipate the extension of the disease, which, if allowed to go on, might ave rendered labor impossible without the infliction of dangerous violence o the parts.

3. In a third order of cases, where the disease is more extensive, having nvaded the upper part of the cervix and lower segment of the uterus, the rue course to adopt is to remove the uterus altogether by Porro's operation. 'pencer Wells[1] relates a successful case.

It may even be contended that this radical operation would be best in all ases in which the disease is presumably limited to the uterus.

The hemorrhages of abortion arise directly from blood being extravasated etween the decidua and fœtal elements of the placenta, disturbing the tero-placental connections; or from disease of the ovum as in hydatiform legeneration. This subject has been discussed as a part of the history of Abortion.

B. The Hemorrhages of Advanced Gestation.

ACCIDENTAL HEMORRHAGE.—By this term is understood simply the emorrhage that breaks out in the course of gestation, usually before the natural advent of labor, the placenta having grown in its normal site—that s, within the fundal and equatorial zones of the uterus. In this sense it is distinguished from placenta prævia, which grows greatly or wholly within he lower zone. The distinction is arbitrary and unphilosophical. Every emorrhage must have a cause; none can strictly be called "accidental." But, bearing this in mind, the term may be retained as a matter of conve- ience.

Convenience, however, is here, as is too often the case, purchased at the expense of truth. The term "unavoidable," as applied to the hemorrhage of placenta prævia, is much too absolute.

There is, however, sound clinical reason for studying the hemorrhages that occur during the latter three months of pregnancy, distinguishing those con- nected with placenta prævia from those which occur when the placenta has grown within the normal boundary.

As we approach the term of gestation, the relations of the placenta to the

[1] Med.-Chir. Trans

uterus differ materially from what obtains in the earlier months. The adhesion becomes less intimate; slighter causes determine its premature detachment; and one circumstance which lends special significance and gravity to the hemorrhages of this period: the liability to partial or complete retention or concealment of the extravasated blood, is almost unknown in the first half of gestation. This important practical distinction we certainly owe chiefly to Rigby's definitions. This distinction and the outflowing clinical indications do not seem to have been adequately appreciated by most French and German authors.

Hemorrhage in the latter months depends essentially upon detachment of the placenta, so that blood flows from the ruptured and bared utero-placental vessels. This general proposition is no less true of the hemorrhages which arise when the placenta grows to the fundus than it is when the placenta grows to the lower zone.

The immediate causes of detachment of the placenta are: (1) Contractions of the uterus, which disturb and break the relations of surface between uterus and placenta. (2) Under especial sudden determination of blood to the uterus and placenta. (3) External violence.

1. Towards the end of gestation, the muscular fibre of the uterus becomes rapidly developed, and *contractility* becomes more and more pronounced. Hence it is that detachment of the placenta is more frequent at this period. Causes that heretofore would have been harmless may now excite *active contraction*. Some degree of contraction analogous to the peristaltic motion of the intestines may commonly be felt by the hand, especially if it be applied cold on the abdomen. If contraction be excessive or sudden, the placenta may be partially loosened. The smallest extravasation between uterus and placenta will excite further contraction; the separation is increased and more blood is effused.

Gendrin gives the following explanation of the mechanism of detachment of the placenta: The muscular structure of the uterus is disposed in two layers, an external and an internal. The relations of these two layers with the vascular layer account for the influence they exercise in the production of hemorrhage. Where spasmodic contractions are excited, the intrauterine vascular plexus being pressed irregularly by these muscular contractions, blood must flow in some points of the placental disk; hence a local congestion which may cause a rupture of the weak venous branches. These contractions, by causing circumscribed puckerings on segments of the uterine globe, necessarily drag upon the placental connections, and may cause their rupture.

2. The second cause may act independently of the first, but with peculiar force when the first is present. *Emotion* will cause contraction of the uterus; it is also a powerful agent in determining a sudden flow of blood to the uterus. The sudden tension of the vessels, aided or not by contraction of the muscular wall, is relieved by extravasation of blood between placenta and uterus. Kiwisch observed that detachment does not always ensue at once upon the nervous shock, and that flooding may not set in until some hours, even days, have passed. Such cases, we think, may be explained by supposing that a slight extravasation takes place at the time, which, acting as an irritant to the uterus, occasions extended contraction a little later. The utero-placental vessels are of extreme delicacy; they form the weakest point of the circulating system. Sometimes extravasation takes place in the placenta itself—placental apoplexy. This will probably lead to detachment.

3. *Violence* in many forms may produce similar results. Direct violence, as from blows upon the uterus, usually assigned as the most common cause, acts in an obvious manner. A blow, even if not bearing immediately upon

the part of the uterus to which the placenta is attached, may, by repercussion or *contre-coup*, throwing the uterine wall into agitation or making it contract, cast the placenta. The movements of the fœtus even may excite sufficient contraction. Coitus in some cases has appeared to be the immediate cause. Detachment of the placenta has been known to follow severe vomiting, straining at stool or coughing, standing at hard work at the wash-tub, lifting heavy weights. These causes may act, not only by the violent succussion, but also by producing uterine and placental hyperæmia. But the frequency of violence as a cause is, we believe, much exaggerated. When violence is the apparent efficient cause, there is frequently preëxisting a predisposing cause in disease of the placenta, of the uterus, or of the blood, or liver, or kidney, or lungs, or heart, or general systemic disorder. We may repeat our aphorism: "The healthy ovum clings to the healthy uterus with wonderful tenacity."

The Predisposing Causes.—This premature separation of the placenta rarely occurs in the young and robust, differing in this respect from the case of placenta prævia. It is most common in women past thirty-five years of age, who have borne many children, whose constitutions are worn by sickness and poverty, perhaps by intemperance, whose tissues are therefore badly nourished, wanting in tone, tending to atrophy or degeneration; in short, in the same class of persons who are most liable to rupture of the uterus. In one case we found fatty degeneration of the heart.

Certain diseases dispose to hemorrhages, and notably to this form. Variola, albuminuria (Blot), leucocythemia (Paterson[1]), acute atrophy of the liver, are amongst the most potent. Disease of the liver, by obstructing the return of blood from the pelvic viscera, will necessarily promote hyperæmia of the uterine venous system; whilst the augmented arterial tension incident to pregnancy will throw increased strain upon the point of meeting of the arteries and tissues at the placenta. Thus the danger of bursting bounds at this, the weakest point of the circulating system, will be very great.

A strong predisposing cause may exist in a *morbid condition of the placenta*, such as fatty degeneration, fibrinous masses, or atrophy, by which the uniformity of its structure is impaired. A diseased placenta, especially one of unequal consistency, containing solid lumps, will not follow and adapt itself to the varying movements of the uterus and the changing superficial area of the placental site so easily as a healthy placenta does. This cause was pointed out by Robert Barnes in his memoirs on "Fatty Degeneration of the Placenta."

A dead fœtus, again, may favor detachment by (1) entailing changes of density and other conditions in the placenta, (2) through retrogression of the muscular and decidual tissues of the uterus, (3) by exciting contraction of the uterus as a foreign body would.

Course and Symptoms.—There may be no premonitory signs. The woman, in her ordinary health, is commonly seized suddenly with (1) *pains in the hypogastric region*, referred more especially to the fundus or one side of the uterus. The pain is often very severe; (2) *shock*, even to the extent of collapse, may ensue. The pain is increased on pressure; (3) quickly sometimes, but sometimes gradually, *great distention or bulging* of the fundus uteri takes place; (4) and with it *loss of regularity of form*. A projection or bump is felt. The uterus projects more than before into the epigastric region; it communicates a doughy feel; the form of the fœtus is lost at this part. These signs are the result of the stretching of the uterus in a circumscribed part by the accumulation of extravasated blood. The histories of severe

[1] Edinburgh Medical Journal, 1870.

cases mostly show that the detachment begins in the middle of the placenta, and proceeds towards the margin under the pressure of the accumulating blood. A cavity is formed for the reception of the blood, partly by inward compression of the placenta, which tends to be separated, and partly by bulging outward of the uterine wall. The placenta, examined after expulsion, is found cup-shaped or concave on its maternal surface, instead of being convex. Oldham described a typical case[1] in which the placenta retained its adhesion all round the margin only, a large mass of blood being imprisoned in the hollow formed between uterus and placenta. The placenta is in Guy's museum. (5) *A fifth* result of the uterine injury and sudden shock is the *absence of true labor-pains.* The uterus is either paralyzed or thrown into disorderly spasmodic action.

It is interesting to note the analogy between these cases and rupture of the uterus. The symptoms often bear a striking resemblance. In both cases there is sudden injury to the uterus. Accidental hemorrhage may, in some cases, be regarded as an alternative of rupture of the uterus. Emotion, by causing sudden concentric pressure, may cause rupture. This catastrophe may be averted if the ovum or its attachments give way. The peritoneal coat has been actually torn under the violent stretching—a fact that deserves to be borne in mind, since it has been produced by the simple mechanical process of forcibly injecting air or water into the uterus for the purpose of inducing labor. Evidence of this will be found in the chapter on "The Induction of Labor."

We must not always look for *external hemorrhage* as a sign. Blood, we have seen, is effused; but it may be retained *concealed.* There are, indeed, the general signs of loss of blood: fainting, blanching, agitation, perhaps deafness or blindness; the skin is cold and clammy; the pulse feeble, dicrotous, or almost extinguished; the features are pinched; the whole aspect indicates suffering and depression. The intensity of these symptoms is commonly greater than can be accounted for by the loss of blood—at any rate, by that which escapes externally. The symptoms, then, are due to the combination with shock.

In some cases, not whole blood, but serum, more or less red, oozes out of the uterus and escapes externally. The crassamentum or clot is retained; the serum is squeezed out under compression. This sign, then, is characteristic of internal hemorrhage and retention. Our attention was first directed to it by E. Calthrop.[2] Hence, when we see a thin, watery blood escaping, we may suspect retention of clot from "accidental" or "concealed" hemorrhage. When the child is born, placenta and black clots come away with a rush.

There is *an order of cases in which the symptoms are comparatively slight.* In these there is no mark of tension of the uterus, and but slight shock or pain. In this order it will generally be remarked that *blood escapes externally;* and it is to this circumstance that the mildness of the symptoms is due. There are cases in which rupture of the membranes, or even expectancy, is sufficient treatment. There being little shock or exhaustion, the uterus quickly reasserts its power. We believe many of these cases of accidental hemorrhage are so in appearance only, and that they really are in their essence cases of placenta prævia. A flap of placenta dips down a little way into the lower zone, and this flap becoming detached, blood readily escapes by the cervix uteri. This fact we have often demonstrated by showing that the rent in the membranes was near the margin of the placenta. This fact must be accepted as circumscribing the number of cases of acci-

[1] Guy's Reports, 1856. [2] Lancet, 1869.

dental hemorrhage. Many are in reality cases of placenta prævia. It must, however, be borne in mind that like causes may produce premature separation of placenta, whatever be the seat of its attachment.

Prognosis.—Cases of this kind, occurring, as they mostly do, under conditions of reduced power, if not of disease, or under violence, where there is little power of recuperation or of resistance, must always be looked upon with anxiety. Death may occur in a few hours, even before delivery, and before there is time to succor. Sometimes the added shock of labor induces fatal prostration; and sometimes further hemorrhage, following the birth of the child, extinguishes what little strength and hope remained. Safety, then, often depends upon early recognition of the nature of the case.

It is impossible to give an approximate estimate of the risk to the mother. The immediate risk to life is serious; the risks she has still to run if she rally from the immediate shock are scarcely less serious. Secondary hemorrhage, continuing shock, peritonitis, metritis, septicæmia, present a formidable array of dangers.

The prospect of the child's survival depends greatly upon the extent of the detachment of the placenta and the time that elapses before its extrication from the womb. In the cases allied to placenta prævia, in which only a flap encroaching within the lower zone is detached, the prospect is good, if the right assistance be given in time. But in the cases of concealed hemorrhage, in which the main bulk of the placenta is tached, the child is generally lost. It perishes of asphyxia, arising from the mother's loss of blood and collapse, even when a portion of the placenta still remains adherent.

It is difficult to estimate the *frequency* of these cases. Goodell[1] in a valuable memoir collected 106 cases; of these 54 mothers perished; and of 107 children, 6 only were known to have been saved. Thus the mortality is greater than in placenta prævia, both for mother and child. The case is even in a higher degree cataclysmic.

Treatment.—The first thing to do in all the cases is to *rupture the membranes.* This by letting off the liquor amnii, takes off the strain upon the uterine fibre, allows the walls to resume their natural condition, and provokes labor. Even before doing this, and at any time when we see prostration marked by feeble pulse, oppressed breathing, and cold skin, we should rally the patient by the subcutaneous injection of a drachm of ether. This may be repeated every half-hour if necessary. The restorative action of this remedy is often as surprising as it is gratifying to witness.

In some cases, in which the prostration is not marked, rupturing the membranes may be enough. Nature will do the rest. To proceed hastily to forced delivery might prove fatal by adding to the shock. Ergot is of doubtful value. If there is great depression, it may prove inert or add to the depression.

Stimulants internally, *warmth* to the extremities, and *friction* are useful in promoting reaction.

This accomplished, the uterus may be enabled to contract, and labor may go on spontaneously. Steady, but not forcible, support may be applied by a bandage.

The next thing, if labor does not set in fairly, is to *dilate the cervix gradually with the water bags.* Before these were introduced, the alternative was to risk letting the woman sink from exhaustion, or to encounter the perhaps greater evil of forcing the hand through the cervix and turning the child to deliver it. Collins says: "I know of no operation more truly dangerous

[1] "On Concealed Accidental Hemorrhage of the Gravid Uterus." Amer. Jour. of Obstetrics, 1869.

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But there is another form of local disease, almost always giving rise to hemorrhage, which demands close attention. This is *malignant disease of the cervix uteri*. In cases of this kind, hemorrhages, at times profuse, occur at the menstrual epochs and at uncertain times; copious serous discharges tinged with blood, and often offensive to the smell, being more or less continuous. Pain is not constant. When these discharges are observed, local exploration may reveal the disease by the enlargement of the vaginal portion, induration, an irregular knobby surface, perhaps ulceration. One event is common, the occurrence or increase of bleeding under the examination. But we must point out that all the conditions mentioned may be found, and yet the case may not be one of malignant disease. We have been consulted on cases so suggestive of cancer that immediate resort to amputation of the diseased cervix, or the preliminary induction of labor, has been strongly urged, and in which the subsequent history proved that there was no cancer. The conditions described are sometimes produced under the simple action of gestation upon a cervix which had previously been the seat of chronic follicular inflammation. The glands or follicles of the vaginal portion become the foci of inflammatory action; hyperplasia with induration is set up, and then when the intense hyperæmia of gestation is added, the swelling is greatly increased, the dark purple congestion and abrasion from epithelial shedding enhance the suspicion of malignancy, and the case is set down as cancer. We have seen all these conditions subside quickly after labor, and the cervix return to the pale smooth appearance of health. It will nevertheless sometimes be difficult to differentiate these cases. It might, perhaps, be stated generally that we should not readily admit the presence of cancer unless it had been fairly diagnosed before the gestation, and unless there is evidence in induration and fixing of the cervix by extension to the vaginal roof.

It may be reasonably suspected that some cases published as successful examples of amputation of cancerous cervix during gestation were examples of the simulated cancer described above.

THE COURSE OF GESTATION COMPLICATED WITH CANCER.—When things are allowed to take their course, the issue is almost invariably disastrous. The disease is not arrested by gestation, hemorrhage and exhausting discharges recur, and when labor sets in there is imminent danger of laceration of the cervix, which may extend and cause rapid death. If the woman escape this catastrophe, she still has to run the hazard of traumatic hemorrhage, which it may be difficult to restrain even by the actual cautery or by ferric chloride. The next danger is from sloughing of the injured tissues and septicæmia. And if she survive all these dangers, she will probably sink at no distant period from the ordinary progress of the disease, the more quickly from the impaired vital powers consequent on labor and puerpery.

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uterus differ materially from what obtains in the earlier months. The adhesion becomes less intimate; slighter causes determine its premature detachment; and one circumstance which lends special significance and gravity to the hemorrhages of this period: the liability to partial or complete retention or concealment of the extravasated blood, is almost unknown in the first half of gestation. This important practical distinction we certainly owe chiefly to Rigby's definitions. This distinction and the outflowing clinical indications do not seem to have been adequately appreciated by most French and German authors.

Hemorrhage in the latter months depends essentially upon detachment of the placenta, so that blood flows from the ruptured and bared utero-placental vessels. This general proposition is no less true of the hemorrhages which arise when the placenta grows to the fundus than it is when the placenta grows to the lower zone.

The immediate causes of detachment of the placenta are: (1) Contractions of the uterus, which disturb and break the relations of surface between uterus and placenta. (2) Under especial sudden determination of blood to the uterus and placenta. (3) External violence.

1. Towards the end of gestation, the muscular fibre of the uterus becomes rapidly developed, and *contractility* becomes more and more pronounced. Hence it is that detachment of the placenta is more frequent at this period. Causes that heretofore would have been harmless may now excite *active contraction*. Some degree of contraction analogous to the peristaltic motion of the intestines may commonly be felt by the hand, especially if it be applied cold on the abdomen. If contraction be excessive or sudden, the placenta may be partially loosened. The smallest extravasation between uterus and placenta will excite further contraction; the separation is increased and more blood is effused.

Gendrin gives the following explanation of the mechanism of detachment of the placenta: The muscular structure of the uterus is disposed in two layers, an external and an internal. The relations of these two layers with the vascular layer account for the influence they exercise in the production of hemorrhage. Where spasmodic contractions are excited, the intrauterine vascular plexus being pressed irregularly by these muscular contractions, blood must flow in some points of the placental disk; hence a local congestion which may cause a rupture of the weak venous branches. These contractions, by causing circumscribed puckerings on segments of the uterine globe, necessarily drag upon the placental connections, and may cause their rupture.

2. The second cause may act independently of the first, but with peculiar force when the first is present. *Emotion* will cause contraction of the uterus; it is also a powerful agent in determining a sudden flow of blood to the uterus. The sudden tension of the vessels, aided or not by contraction of the muscular wall, is relieved by extravasation of blood between placenta and uterus. Kiwisch observed that detachment does not always ensue at once upon the nervous shock, and that flooding may not set in until some hours, even days, have passed. Such cases, we think, may be explained by supposing that a slight extravasation takes place at the time, which, acting as an irritant to the uterus, occasions extended contraction a little later. The utero-placental vessels are of extreme delicacy; they form the weakest point of the circulating system. Sometimes extravasation takes place in the placenta itself—placental apoplexy. This will probably lead to detachment.

3. *Violence* in many forms may produce similar results. Direct violence, as from blows upon the uterus, usually assigned as the most common cause, acts in an obvious manner. A blow, even if not bearing immediately upon

f the uterus to which the placenta is attached, may, by repercus-
ntre-coup, throwing the uterine wall into agitation or making it
ast the placenta. The movements of the fœtus even may excite
contraction. Coitus in some cases has appeared to be the imme-
e. Detachment of the placenta has been known to follow severe
straining at stool or coughing, standing at hard work at the wash-
g heavy weights. These causes may act, not only by the violent
, but also by producing uterine and placental hyperæmia. But
ency of violence as a cause is, we believe, much exaggerated.
lence is the apparent efficient cause, there is frequently preëxisting
sing cause in disease of the placenta, of the uterus, or of the blood,
r kidney, or lungs, or heart, or general systemic disorder. We
t our aphorism: "The healthy ovum clings to the healthy uterus
lerful tenacity."

redisposing Causes.—This premature separation of the placenta
urs in the young and robust, differing in this respect from the case
a prævia. It is most common in women past thirty-five years of
ave borne many children, whose constitutions are worn by sick-
poverty, perhaps by intemperance, whose tissues are therefore
rished, wanting in tone, tending to atrophy or degeneration; in
the same class of persons who are most liable to rupture of the
n one case we found fatty degeneration of the heart.

diseases dispose to hemorrhages, and notably to this form. Variola,
ria (Blot), leucocythemia (Paterson[1]), acute atrophy of the liver,
st the most potent. Disease of the liver, by obstructing the return
rom the pelvic viscera, will necessarily promote hyperæmia of the
nous system; whilst the augmented arterial tension incident to
will throw increased strain upon the point of meeting of the
d tissues at the placenta. Thus the danger of bursting bounds at
eakest point of the circulating system, will be very great.

g predisposing cause may exist in a *morbid condition of the placenta*,
tty degeneration, fibrinous masses, or atrophy, by which the uni-
its structure is impaired. A diseased placenta, especially one of
onsistency, containing solid lumps, will not follow and adapt itself
ying movements of the uterus and the changing superficial area
cental site so easily as a healthy placenta does. This cause was
t by Robert Barnes in his memoirs on "Fatty Degeneration of the

fœtus, again, may favor detachment by (1) entailing changes of
d other conditions in the placenta, (2) through retrogression of
lar and decidual tissues of the uterus, (3) by exciting contraction
rus as a foreign body would.

and Symptoms.—There may be no premonitory signs. The woman,
inary health, is commonly seized suddenly with (1) *pains in the
e region*, referred more especially to the fundus or one side of the
The pain is often very severe; (2) *shock*, even to the extent of col-
ensue. The pain is increased on pressure; (3) quickly sometimes,
imes gradually, *great distention or bulging* of the fundus uteri takes
) and with it *loss of regularity of form*. A projection or bump is
uterus projects more than before into the epigastric region; it
ates a doughy feel; the form of the fœtus is lost at this part.
s are the result of the stretching of the uterus in a circumscribed
he accumulation of extravasated blood. The histories of severe

[1] Edinburgh Medical Journal, 1870.

ental hemorrhage. Many are in reality cases of placenta prævia. It must, owever, be borne in mind that like causes may produce premature separaion of placenta, whatever be the seat of its attachment.

Prognosis.—Cases of this kind, occurring, as they mostly do, under condiions of reduced power, if not of disease, or under violence, where there is ittle power of recuperation or of resistance, must always be looked upon ith anxiety. Death may occur in a few hours, even before delivery, and efore there is time to succor. Sometimes the added shock of labor induces ital prostration; and sometimes further hemorrhage, following the birth of he child, extinguishes what little strength and hope remained. Safety, then, ften depends upon early recognition of the nature of the case.

It is impossible to give an approximate estimate of the risk to the mother. he immediate risk to life is serious; the risks she has still to run if she rally rom the immediate shock are scarcely less serious. Secondary hemorrhage, ontinuing shock, peritonitis, metritis, septicæmia, present a formidable array f dangers.

The prospect of the child's survival depends greatly upon the extent of he detachment of the placenta and the time that elapses before its extricaion from the womb. In the cases allied to placenta prævia, in which only flap encroaching within the lower zone is detached, the prospect is good, f the right assistance be given in time. But in the cases of concealed hemorhage, in which the main bulk of the placenta is tached, the child is generally ost. It perishes of asphyxia, arising from the mother's loss of blood and collapse, even when a portion of the placenta still remains adherent.

It is difficult to estimate the *frequency* of these cases. Goodell[1] in a valuable memoir collected 106 cases; of these 54 mothers perished; and of 107 children, 6 only were known to have been saved. Thus the mortality is greater than in placenta prævia, both for mother and child. The case is even in a higher degree cataclysmic.

Treatment.—The first thing to do in all the cases is to *rupture the membranes.* This by letting off the liquor amnii, takes off the strain upon the uterine fibre, allows the walls to resume their natural condition, and provokes labor. Even before doing this, and at any time when we see prostration marked by feeble pulse, oppressed breathing, and cold skin, we should rally the patient by the subcutaneous injection of a drachm of ether. This may be repeated every half-hour if necessary. The restorative action of this remedy is often as surprising as it is gratifying to witness.

In some cases, in which the prostration is not marked, rupturing the membranes may be enough. Nature will do the rest. To proceed hastily to forced delivery might prove fatal by adding to the shock. Ergot is of doubtful value. If there is great depression, it may prove inert or add to the depression.

Stimulants internally, *warmth* to the extremities, and *friction* are useful in promoting reaction.

This accomplished, the uterus may be enabled to contract, and labor may go on spontaneously. Steady, but not forcible, support may be applied by a bandage.

The next thing, if labor does not set in fairly, is to *dilate the cervix gradually with the water bags.* Before these were introduced, the alternative was to risk letting the woman sink from exhaustion, or to encounter the perhaps greater evil of forcing the hand through the cervix and turning the child to deliver it. Collins says: "I know of no operation more truly dangerous

[1] "On Concealed Accidental Hemorrhage of the Gravid Uterus." Amer. Jour. of Obstetrics, 1869.

both to mother and child than the artificial dilatation of the os uteri and turning the child." This opinion, of course, is based upon the operation of forcing the hand through the cervix and then turning. He relates a case in which laceration of the uterus was thus caused. If the hydrostatic bags are used there is no operation more safe. When there is sufficient dilatation, you may deliver by the forceps if the head present; or if the symptoms be urgent, and the child is presumably dead, it will be better to make delivery easier and quicker by perforating the head and extracting by craniotomy forceps or cephalotribe. If any other part than the head present, deliver by bipolar turning.

The ruling principle should be to proceed with as little precipitation and force as possible, economizing the woman's strength.

When the child is delivered, the placenta comes away with a mass of clotted and fluid dark blood. It is not wise in these cases to employ *kneading* the uterus or *expression* unless with extreme care; and kneading is better avoided altogether. If the placenta does not come readily under steady but gentle compression of the uterus, it is better, after a subcutaneous injection of a drachm of ether, to extract it gently by the hand. As soon as this is done, inject a stream of hot water, 110° F., into the uterus. This will do much to arrest or avert hemorrhage, and will help to rally the patient's strength. Should this fail and hemorrhage persist, we must have the courage to swab the interior of the uterus with a solution of perchloride or persulphate of iron, unless we are prepared to let the woman bleed to death. The extreme depression forbids all trust in agents which depend for their efficacy upon a reserve of power in the system. The paralyzed, injured uterus allows fresh hemorrhage.

PLACENTA PRÆVIA.

Before the time of Levret and the elder Rigby hemorrhages from placenta prævia and the hemorrhages described in the preceding section were commonly confounded. The distinction is based upon the following characters: In both cases the hemorrhage proceeds from the uterine surface, from which the placenta has been detached. In accidental hemorrhage the placenta had grown within the normal region of the body of the uterus—that is, above Bandl's ring (see Figs. 83 and 84). In unavoidable hemorrhage, the placenta had grown wholly or in part in the lower segment of the uterus—that is, below Bandl's ring. These two parts we have seen are differently endowed. The body proper above Bandl's ring is capable of more vigorous contraction than the segment below it, and therefore the utero-placental vessels bared on separation of the placenta are more readily closed. Robert Barnes, who had, on physiological and clinical evidence, anticipated Bandl's anatomical demonstration differentiating these two regions of the uterus, divided the body of the uterus into three zones: (1) the upper, or fundal; (2) the middle, or equatorial; and (3) the lower, or cervical zone. This last zone is identical with Bandl's lower segment.

THE THEORY OF UNAVOIDABLE HEMORRHAGE.—Levret and Rigby, who first clearly perceived that this form of hemorrhage was connected with implantation of the placenta at the lower part of the uterus, did not, however, rightly estimate the conditions upon which the hemorrhage depended. They held that so long as the labor continued, hemorrhage would go on, even increasing—that is, the hemorrhage is unavoidable. The therapeutical corollary drawn was that "manual extraction of the fœtus by the feet was absolutely necessary to save the life of the mother." Almost all subsequent authorities concurred in accepting the doctrines and in adopting the practice of Levret and Rigby.

Denman is absolute in his sentence. He says: "It is a practice established by high and multiplied authority, and sanctioned by success, to deliver women by art in all cases of dangerous hemorrhage, *without confiding in the resources of the constitution*. This practice is no longer a matter of partial opinion, on the propriety of which we may think ourselves at liberty to debate."

Ingleby expresses the theory thus: "And thus the placenta will undergo a continuous separation, corresponding to the successive expansion of the neck, *until nearly the whole of the surface* is dissevered from its uterine connection. From this it is evident that, when the placenta is affixed either to

FIG. 154.

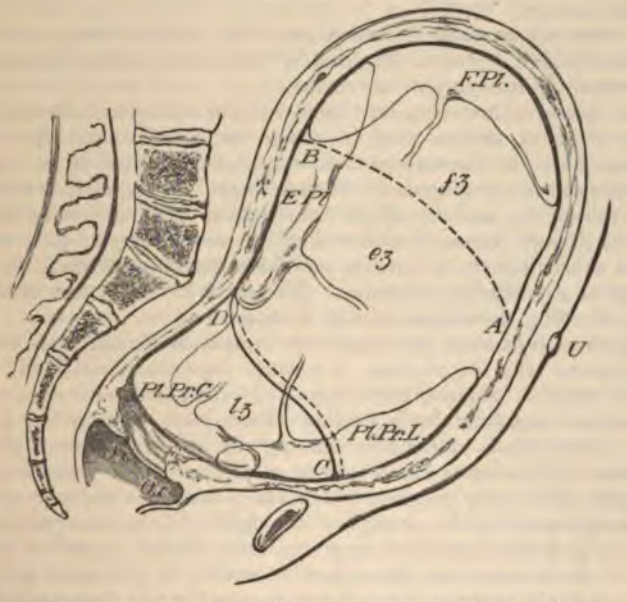


DIAGRAM ILLUSTRATING BARNES'S THEORY OF PLACENTA PRÆVIA. (R. B.)

Division of uterus into zones: *A B*. Upper polar circle. *C D*. Barnes's lower polar circle or Bandl's ring. *E F*. Circle of os internum. *Os*. Os externum. *f.z.* Fundal zone. *e.z.* Equatorial zone. *l.z.* Lower zone. *F.Pl.* Fundal placenta. *E.Pl.* Equatorial placenta. *Pl.Pr.L.* Placenta prævia lateralis. *Pl.Pr.C.* Placenta prævia centralis.

the cervix or os uteri, *whether wholly or partially*, the vessels will become exposed on each successive detachment, and the ultimate safety of the patient will depend upon delivery by turning the child, excepting, perhaps, in two peculiar states, in which rupture of the membranes is the only treatment offered to us in one case, and the safest and therefore the most eligible in the other. Pain, efficacious as it is in the accidental form of hemorrhage, unless adequate to the expulsion of the child, is neither to be expected nor to be desired to any material extent in the unavoidable form, as it only renders the effusion more abundant; for though a certain degree of relaxation is necessary, it must be remembered that, in exact ratio as the cervix uteri is successively developed and the os internum progressively dilated, will an additional mass of placenta be detached from its connecting medium, and hemorrhage be renewed.[1]

[1] Uterine Hemorrhage, 1832.

Cazeaux says, since the time of Levret the insertion of the placenta over the neck of the uterus has been considered as an inevitable cause of hemorrhage during the last three months of pregnancy and in labor. Gardien says the loss is then of the very essence of pregnancy, and especially of labor.

Nothing can be more hopeless than this theory. Hecatombs of women and of infants have been its victims. The logic is unrelenting, but the premises are false. Pain—that is, contraction—is the thing wanted to effect labor; but if it comes, and come it must, it brings mortal danger with it. Expansion of the cervix uteri is a necessary condition of labor, but the cervix cannot expand without causing more hemorrhage. Thus Nature is utterly at fault. She is condemned without appeal, without the opportunity of asserting her power.

There were not wanting, however, men who did not accept this theory in all its absolutism. Puzos, Wigand, d'Outrepont, Robert Lee, recognized cases in which Nature might be trusted.

Mercier seems to have been so struck with the occasional absence of hemorrhage in placenta prævia that he wrote an essay under the title, "Les accouchements où le placenta se trouve apposé sur le col de la matrice sont-ils constamment accompagnés de l'hémorrhagie?" Cazeaux recognized cases of dilatation of the neck in which "not a drop of blood" was lost.

In 1847, Robert Barnes first sketched the new theory of placenta prævia, which he subsequently, in various publications, demonstrated by abundant physiological and clinical evidence. This theory will be now set forth. He began by dividing the uterus into three zones.

Testing this division of the uterus into zones, physiologically, we may find obvious reasons *why the placenta is usually implanted within the two upper zones of the uterus.* Some of these are: (1) to insure due circulation between the uterus and placenta during labor, interrupted only during active contraction; (2) to admit of equable casting off of the placenta after uterine contraction; (3) to leave the lower zone of the uterus free from vascular hypertrophy, this being the part which has to bear the violence of distention and bruising attending the passage of the child; (4) to preserve the placenta from injury and detachment during the latter end of gestation and during labor. Of these two zones, the upper, or fundal, is the more propitious, as it most completely insures the conditions set forth. The fundal seat then is the most natural. It is *κατ' ἐξοχήν* the region of safe placental attachment. The equatorial space between the upper and lower polar circles is the next in point of safety. It is the region of equatorial placenta. This placenta is not liable to previous detachment. Attachment here may, however, cause obliquity of the uterus, oblique position of the child, lingering labor, and dispose to retention of the placenta and post-partum hemorrhage.

Below the lower circle is the lower zone, which we have occasionally called the "cervical zone," since it touches the cervix below. But since this term has seemed to some ambiguous, and has apparently raised the idea, nowhere justified by the text, that the placenta grew within the cervical cavity, we here use the term "lower zone." This is the region of dangerous placental attachment. All placenta fixed here contravenes the four reasons why Nature usually plants the placenta within the two upper zones. During gestation the head, if presenting, is constantly pressing upon the placenta within this lower segment; during labor the head presses still more forcibly upon the placenta, bruising it, perhaps detaching it, and the child has to be driven through the lower segment and cervix, enlarged and more vulnerable by excessive vascular hypertrophy, thus predisposing to the ills of laceration, hemorrhage, and septicæmia. Lastly, it will appear that since this lower segment *must be dilated* to give passage to the child, retrac-

tion or shortening must occur, and this is incompatible with the preservation of the cohesion between the uterus and the placenta within this zone. In every other part of the uterus there is an easy relation between the contractile limits of the muscular structure and that of the cohering placenta. Within this lower region the due relation is lost.

The lower polar circle, then, is the physiological line of demarcation between prævial and lateral placenta. It is the boundary line below which we have spontaneous placental detachment and "unavoidable hemorrhage," above which spontaneous placental detachment and hemorrhage do not occur.

This lower circle or physiological boundary line between safe and dangerous placental attachment, demonstrated by Robert Barnes, in 1847, is identical with Bandl's ring. It is interesting to note how closely this discovery, flowing from clinical and physiological study by Robert Barnes, and that subsequently made by anatomical study by Bandl, confirm each other, and demonstrate what really constitutes placenta prævia.

The exact position of the lower polar circle or boundary, the line between hemorrhage and safety, can be determined with considerable accuracy. By physiological necessity the lower segment of the uterus must open to an extent corresponding to the circumference or equator of the child's head in order to permit of its extrusion. Beyond this extent there is no physiological necessity for expansion, and it does not expand. Now, by noting the amount of recession or shortening of the lower segment to reach this extent of expansion, we shall obtain the exact measure of the original depth of the lower zone—that is, of the region of prævial placental attachment (see Fig. 154).

This point may be further demonstrated by the following simple proceeding. Take a fœtal skull, and marking the left parietal protuberance for a centre, stretch an India-rubber ring over the circle of greatest circumference of the skull, preserving it at equal distance from the centre. This ring will represent exactly the greatest expansion of the lower segment and cervix necessary for the passage of the head. To this extent the parts *must expand;* beyond this *they need not and will not expand.* It, therefore, marks the limit between the lower and equatorial portions of the uterus.

If we now measure the distance between the presenting parietal protuberance of the fœtal head and any part of the line of greatest circumference, we shall have the utmost extent of the lower zone. In a full-sized fœtal head this is about 3 inches or 8 cm. If we now describe a circle within the womb at three inches from the undilated os internum, we shall have drawn the lower polar circle. This is nearly exactly what the finger passed inside the womb can do.

We believe, however, that the boundary line of safety is often practically reached before the expansion of the mouth of the womb has reached the full diameter of the child's head. We have observed that the hemorrhage has completely stopped when the os uteri had opened to a diameter of from 2 to 3 inches.

This, the original statement of Robert Barnes's discovery of the distinctions between the upper part and the lower third of the uterus, and the boundary line defining the limit of expansion of the lower segment and of placenta prævia, should be compared with the anatomical description of Bandl's ring and lower segment, and with the following extracts from Spiegelberg and Duncan.

Spiegelberg confirms Robert Barnes's discovery, stating the case in the following manner:[1] "The expansion of the lower segment of the uterus is

[1] Lehrbuch der Geburtsh., 1878.

greatest at the points which lie nearly at right angles to the axis of the organ, and thus in nearest proximity to the os internum; the expansion lessens the higher these points lie, and the more parallel they run with the uterine axis. This parallelism begins at a distance, at the highest of 6 cm., from the middle of the os internum, measured in a continuous line, from 4 cm. in perpendicular distance. A circle drawn at this boundary transversely across the uterus has a diameter of about 11 cm., and this is enough to permit the fœtus to pass. Thus *there is no further expansion above* 6 cm. *from the middle of the os internum. Thus the placenta is prævious when it runs over partially or wholly in the segment thus marked out;* the necessary effect of the last expansion at the time of labor is the separation of the placenta, and this is as physiological as is the separation at the normal site through shortening of the adhesion-surface in consequence of concentric contraction."

Duncan says:[1] "At about 2½ inches from the vertex (the os internum) the diameter of the uterine cavity is 4 inches, and this is about 1½ inches above the vertex, measuring along the uterine axis. A canal of 4 inches in diameter is large enough to transmit the fœtus. There is, therefore, no need for expansion to any considerable amount above that circle of latitude, which is distant 2½ inches, measured along a meridian from the centre of the internal os." There is some difference in Duncan's estimate of the height of the extreme diameter from the os internum. He gives 2½ inches; we give, approximately, 3 inches, our estimate being based on measurements made on the fœtal skull from the parietal protuberance to the equator, a method which we submit is physiologically true, as defining the circle of necessary dilatation. This difference does not affect the confirmation afforded of Barnes's discovery. But in another passage Duncan bears clearer testimony: "Barnes, however, has distinguished himself by the care with which he has justly insisted on the natural limit of spontaneous premature separation, and has shown that it is not the case, as Churchill says, that the more the labor advances the greater is the separation, the utmost limit of separation being reached before the first stage of labor is completed."

When the dilatation of the cervix has reached the stage at which the head can pass, and when all that part of the placenta which had been adherent within the lower zone is detached, and if, as is the constant tendency of Nature to effect, the intermitting active uterine contractions arrest the hemorrhage, a stage is reached when the labor is freed from all prævial placental complication; the lateral or equatorial portion of placenta retains its connection, supporting the child's life. The labor henceforth is a natural labor. The bleeding stops, owing partly to the tonic continuous retraction of the lower uterine segment, which closes the mouths of the vessels, and favors thrombotic plugging.

This is the course which Nature strives to accomplish, and not seldom does accomplish. We have frequently verified it at the bedside. Many cases are recorded by old and recent authors in which this course was successfully accomplished, although the narrators failed to interpret the phenomena correctly. If observations in point are not more abundant, it is simply because men, acting servilely under the thraldom of the "unavoidable hemorrhage" dogma, fear to let Nature have a chance of vindicating her powers. The instant resort to the *accouchement forcé* interrupts the physiological process. We can see no more.

[1] Contributions to the Mechanism of Natural and Morbid Parturition, 1875. (Memoir date, 1873.)

Description of the Varieties of Placenta Prævia.

Four forms may be distinguished:

1. The complete or so-called *central placenta*. The os internum uteri is quite covered by placenta. This rises on all sides up from the os as from a centre, occupying a complete ring of the lower zone. In this form the examining finger touches the placenta itself.

2. Occasionally the area occupied by the placenta extends not only over the entire lower segment of the uterus, but rises up on all sides, covering all the equatorial zone as well, and leaving only a small area at the fundus free. Such a case we have seen and figured. The woman died under the hands of a midwife. We removed the uterus with placenta attached as described, and took it to the College of Surgeons.

3. *The Lateral Placenta.*—The placenta dips down on one side of the lower zone, so that an edge reaches the os internum without passing over it. In this form, the finger, on examining, touches the bag of membranes.

4. *The partial placenta prævia*, called by some *placenta lateralis*. A flap or margin of placenta descends below Bandl's ring, but does not come down to the os internum. It has encroached within the lower zone. In this form the examining finger touches the bag of membranes.

The second form may usually be verified during the labor by feeling the edge of the placenta and the continuous bag of membranes, if this bag be still unbroken; and, if burst, the fingers may make out both maternal and fœtal surfaces of the placenta. After the expulsion of the placenta, the two latter forms are demonstrated by noting the position of the rent in the membranes in relation to the lower edge of the placenta. The distance between the rent and this edge gives, as Levret, Maygrier, Hugh Carmichael, Von Ritgen, and numerous observations of our own show, the exact distance of the edge of the placenta from the os internum.

We find it stated in our note-books that in twenty-seven per cent. the placenta comes within two inches of the os internum.

Another point of physiological and clinical interest described by Levret was the frequent origin of the cord from the lowermost margin of the placenta. He even said that the origin of the cord held a certain relation to the seat of the placenta. Thus, in fundal placentas the cord springs from the middle, whilst in lateral placenta and placenta prævia it takes its rise lower down in proportion. Thus the cord follows and marks the extent of the descent of the placenta. We have studied this point, and are bound to say that we have found not a few exceptions. The placenta figured (Fig. 156) is one. Still, we believe that Levret's law, if not universal, is generally true.

The Causes or Etiology.—It is not possible to lay down any positive exposition of the causes which determine the development of the placenta at the lower segment of the uterus. But we may usefully state some of the more frequently observed associated conditions. Amongst the chief of these is the fact that placenta prævia is much *more frequent in pluriparæ* than in primiparæ. It is apt to recur in successive pregnancies. Osiander showed the greater aptitude of the ovum to attach itself to the lower segment in pluriparæ. As might be expected, it occurs more frequently with twins; the double placenta demanding a larger area, there will be more likelihood of encroachment on the lower zone. In some cases the placenta, even single, is unusually thin, and is spread out over a larger area in order to make up for diminished thickness. We have referred to one very striking case of this kind. We have seen reason to believe that, when the placenta grows in the lower zone, it may be flattened out under the continuous pressure of the

child's head. Being thus prevented from increasing in thickness, it spreads out in area. But this is not universal, as may be seen in Hunter's figure, which represents a central placenta of the ordinary thickness.

As we have already seen, the chorion is primarily covered uniformly with villi, whilst, on the other hand, the entire surface of the uterus down to the margin of the os internum is clothed with decidua. Hence the two conditions: chorion, provided with the structure to contribute fœtal placenta from any part of its surface; and uterus, providing structure to contribute the maternal element of placenta. It is a matter of observation that placenta actually is formed at any part of the uterine surface. What the accidental conditions are that generally determine its development from a limited part of the chorion and a limited part of the decidua, we cannot precisely say. We may conjecture that the decidua at the fundal part is sometimes less healthy, and that the chorion-villi, like the radicles of a plant, will push out in another direction in search of a more suitable soil. Or we may suppose, what is more likely, that the ovum entering from the Fallopian tube is not immediately caught in a fold of decidua, but drops to a lower spot and there becomes attached. It has even been surmised that an ovum, having entered the uterus and dropped to the lower part of the uterus, has become impregnated there, and so grows on the spot of impregnation.

It has been said to be more frequent in women subject to hard work. *Is* it more frequent in the subjects of retroversion of the uterus?

Küneke ("Monatsschrift für Geburtskunde," 1859) and Sirelius ("Archives Gén. de Médecine, 1861) describe cases of placenta prævia, in which the prævious portion was a supplementary placenta. Hecker had pointed out the same thing.

A speculation or hypothesis of Rokitansky, in reference to the origin of placental polypi and fibrinous polypi, deserves notice in this connection. Rokitansky submits that an ovum, after fixing itself in the mucous membrane of the uterus, and after complete clothing with decidua, may be driven down by uterine contractions into the cervical canal; its attachment lengthening into a stalk, the ovum continues to grow in the yielding cervix. Then ensue death of the ovum, hemorrhage, and removal. In like manner we may conjecture that the ovum, originally grafted near the tubal orifice, may be driven down or pressed down partly into the lower uterine zone, and be there supported partly by shooting out of chorionic villi. This hypothesis would agree with the frequent large expanse of placenta in placenta prævia, and also with the phenomenon of placenta succenturiata.

It is also possible, as we have cited elsewhere, that the ovum may grow within the true cervical cavity.

The *frequency* of placenta prævia can hardly be stated with any approach to precision. Schwarz, Spiegelberg, Schwörer, and Hegar's collected statistics give, in a total of 562,120 labors, 394 cases of placenta prævia, or about 1 in 1400.

In 20,084 labors in the Royal Maternity Charity, during the five years 1878–1883, there occurred 28 cases of placenta prævia, with 5 maternal deaths. Thus we get 1 case of placenta prævia in 700 nearly. And even this, we believe, is below the reality. In 1580 cases in the practice of the British Lying-in-Hospital, during the years 1872 to 1881, there were 3 cases of placenta prævia.

Theories of the Cause of the Bleeding.—1. There is the old one that it results from the expansion or growth of the lower segment of the uterus in the later months of gestation; or of the cervix, to which the placenta has by some been supposed to grow, exceeding the accommodating

capacity of the placenta, and thus, the placenta being detached, blood escapes from the torn utero-placental vessels.

We think it desirable to quote from the "Obstetric Operations" (3d ed., 1876) the following appreciation of this view: "This doctrine, passed on traditionally, and accepted almost without question, is undoubtedly founded on an anatomical and physiological error. Stolz clearly showed that the cervix proper contributes in no way to the reception of the ovum. The cervical canal may frequently be felt nearly closed above by the narrow os internum uteri at the end of pregnancy" (see pp. 188, 192).

2. Then the question arises as to the cause of the hemorrhage which breaks out at the time of labor. This is commonly attributed to the active expansion of the lower part of the womb and cervix. Is this consistent with clinical observation? It is an indisputable fact that the hemorrhage frequently breaks out before there is any expansion of the lower uterus or cervix at all. We have on many occasions felt the os internum so closed as hardly to admit the tip of the finger after severe flooding had been going on.

FIG. 155.

THE MATERNAL ASPECT OF A PLACENTA PRÆVIA (¾ NAT. SIZE.) THE LOWER PART IN FORM OF A FLAP OCCUPIED THE LOWER ZONE OF THE UTERUS. (From a drawing given by Dr. Roper.)

Bobert Barnes submitted a theory the very reverse of that generally accepted. He urged that the part endowed with the most active growth is the ovum, the placenta; that the growth of the uterus is secondary upon the stimulus imparted by the growth of the ovum. He inferred that the first detachment of placenta arose from an excess of growth of the placenta over that of the lower region of the uterus to which it was attached; that the structure of this uterine region was ill-fitted to keep pace with the placenta; hence loss of relation, the placenta shoots beyond its site, and hemorrhage results. Again, hemorrhage is most common at the menstrual epochs, and has not necessarily anything to do with labor. Frequently, indeed, labor does not even follow. At the menstrual nisus there is an inceased flux of blood to the

and to the placenta. This over-filling of the placenta makes it too fit the area of its attachment; it breaks away at the margin, and escapes. Under the irritation of this partial detachment, the infiltration of some blood into the soft substance of the placenta, which increases bulk of the organ, and the insinuation of some blood, perhaps clotting, between the placenta and the uterine wall, active contraction of the uterus be excited. Then the retracting lower zone may detach more placenta; this is secondary.

This theory that the first loss of relation between the uterus and placenta due to the excess in rate of growth and periodical hyperæmia of the placenta is strengthened by the analogous case of tubal gestation. Like tubal station, gestation in the lower segment of the uterus is an example of *error i;* both are alike instances of ectopic gestation. In both the ovum grows a structure ill adapted to harbor it. This want of adaptation consists in unfitness to grow with the advancing growth of the ovum. Hence, in the

FIG. 156.

THE FŒTAL ASPECT OF SAME PLACENTA. THE PRÆVIOUS FLAP IS MORE CLEARLY SHOWN. THE LINE WHICH DISTINGUISHES THIS FLAP FROM THE BODY OF THE PLACENTA MARKS THE BOUNDARY BETWEEN THE [illegible] AND EQUATORIAL ZONES OF THE UTERUS OR BANDL'S RING.

case of tubal or intestinal gestation, there comes a time when the growth of the ovum is so rapid that the sac, not able to keep pace with it, bursts. This catastrophe also commonly happens near a menstrual period, when increased growth is exaggerated by increased afflux of blood. Robert Barnes drew attention[1] to a fact, now generally recognized, that, before the rupture of the Fallopian sac in tubal gestation, discharges of blood by vagina often take place. This is evidence of the ovum outstripping its habitat and getting partially detached. This is exactly what happens in placenta prævia. It is, then, in the history of menstruation and of tubal gestation that we must look for the true light-bearing analogy of placenta prævia.

[1] Clinical History of Diseases of Women.

3. An efficient cause of hemorrhage, initiative and continuous, we believe to be irregular spasmodic uterine contractions. The presence of the placenta over the os uteri is a cause of reflex irritation; and irritation, once begun, is almost certain to go on, and this in an irregular, metastatic manner. There is perverted polarity.

Another highly probable cause of premature detachment of placenta and bleeding lies in the altered state of the flap of prævia placenta. In some cases (see Figs. 155 and 156) this portion becomes partially atrophied or indurated, so that its texture loses its natural harmony with the uterine wall. In this state comparatively slight disturbing causes, as shock, succussions, or dynamic changes in the circulation, may cause detachment.

It is reasonable to conclude that, in some cases, bleeding breaks out from similar causes to those which are in operation in the so-called "accidental hemorrhage." Indeed, some of these conditions—as that just mentioned, alteration in the tissue of the placenta—are perhaps more frequent when the placenta is prævious.

4. Dr. Nagel ("Annalen d. Charité-krankenhauses zu Berlin," 1863) states as a cause of premature detachment of placenta the early rupture of the membranes when the head is low, and os uteri completely dilated. Under these conditions, the advancing head, dragging on the membranes, pulls on the placenta. This may apply to cases of fundal or meridional placenta, as well as to the prævial placenta.

Theories of the Source of the Blood.

We assume, of course, that there is no hemorrhage until the placenta is detached from the uterus. When this detachment has taken place, there are two bared surfaces presenting mouths of torn vessels. Does the blood flow from the placental surface or from the uterine, or from both? Levret believed that the placenta yielded a portion of the blood. Rawlins, of Oxford,[1] says: "The blood proceeds more from the vessels of the placenta than from the denuded vessels of the uterus." Professor Hamilton held the same opinion. Kinder Wood, Radford, and Simpson adopted it. If the blood find its exod through the placenta, it follows that, on detachment of the placenta, the vessels torn on the corresponding surface of the uterus get closed, whilst the blood continues to flow on into the placenta at the part still maintaining its connection with the uterus, and that, so flowing on through the placenta, it will escape at the detached surface. Arguing from this basis, Simpson contended that when the entire placenta was separated there would be no more bleeding, and hence insisted that the proper practice was to complete the detachment. Summed up, the argument would be, that when the placenta is wholly detached no blood can get into it, and therefore the hemorrhage ceases, since none comes from the bared surface of the uterus. Robert Lee, with characteristic keenness, asked: "How is it, then, that furious flooding takes place when the placenta is in the pot under the bed?" Simpson rested his case very much upon the fact that in those cases of placenta prævia in which the placenta is wholly cast off and expelled before the birth of the child, there was little or no hemorrhage, and that it stopped on the expulsion. If Nature so cast the placenta and stopped the bleeding, so, then, ought the surgeon to detach the placenta, and the same result—arrest of flooding—might be expected. Radford, before Simpson, had been led from similar clinical observations to adopt the same practice.

We are not aware that this hypothesis of the placental source of the

[1] Dissertation on the Obstetric Forceps, 1793.

bleeding is now advocated by any one of authority. The little evidence adduced in its support is entirely fallacious. In the Lettsomian Lectures (1857), Robert Barnes pointed out that when flooding ceased on the spontaneous total detachment of the placenta, it was because the detachment was effected by active contraction of the uterus; this contraction closes the utero-placental vessels just as it does in *post-partum* hemorrhage. And then, again, there are cases in which the hemorrhage does not stop on total detachment of the placenta, effected spontaneously or artificially. Cases in point are not uncommon. Let us cite one so complete that it cannot be contested. Joseph Clarke relates: "Mrs. A. was dying when he arrived. The hemorrhage had been *immense*. She died undelivered; and on examination the placenta had been found *entirely* separated." (The italics are in the original.) This is because the uterus does not contract. Ramsbotham, Tyler Smith, and all subsequent writers accept this explanation. That any great amount of blood cannot flow quickly and in gushes through the placenta was proved by the Hunters, who showed that the cavernous structure of the maternal placenta could only permit of a slow uniform current back from the utero-placental arteries to the sinuses. Again, Legroux relates[1] two cases of fatal hemorrhage from placenta prævia, in which dissection showed that the fœtus had long been dead. In these, he argued, the placental circulation must have ceased, and that the source of bleeding must have been the uterus. The late Dr. Mackenzie made experiments bearing directly upon this question. 1. Having opened the uterus of a pregnant bitch, and detached the placenta, he observed that the blood flowed freely from the uterus, and that it was *arterial*. 2. Having partially detached the placenta in a woman, he injected defibrinated blood into the hypogastric arteries. He again observed that the blood flowed exclusively from the uterus, and from the *utero-placental arteries*. 3. He adduces the recorded observations of many practitioners to show that the blood-flow in cases of placenta prævia is arterial in color.

The blood has often been seen flowing direct from the uterine surface in cases of Cæsarean section and of inverted uterus, both with partial and complete separation of placenta. We ourselves bear testimony to these facts. The late Dr. Chowne collected a mass of evidence of this kind. It must further be observed that the languid current through the placenta must be quickly stopped by coagulation. The detached part of the placenta is often found hard and impervious from this cause.

We may, then, fairly conclude that the blood flows mainly from the bared uterine surface, and not from the placenta.

On the other hand, it is probable, as Duncan points out, that bleeding may ensue from rupture of a marginal utero-placental sinus within the area of spontaneous premature detachment, and also from the *circular sinus* of the placenta.

The state of the placenta that is prævious deserves careful study. We have frequently found it presenting blood-extravasations in different states—some, recently effused, still fluid; some in various stages of coagulation and condensation. In some cases the placental tissue is obviously ruptured. This injury takes place either spontaneously during labor or is caused by the manipulations of the physician. In some cases the flap is thinned as if from compression by the head; the structure has undergone a form of atrophy partly from old effusions, some of which have been decolorized, leaving fibrinous masses such as we have described elsewhere (p. 395). The figures (155, 156) represent conditions of this kind.

The question whether a portion of detached placenta can become reunited

[1] Archives gén. de Médecine, 1855.

the uterus has given rise to discussion. It is obviously very difficult to obtain proof of this from direct observation. The anatomical characters of the normal union between uterus and placenta seem almost to exclude the possibility of such reunion.

TRAUMATIC HEMORRHAGE.—Strictly speaking, the hemorrhage ensuing on detachment of placenta is traumatic. But this is a physiological and unavoidable traumatism. The traumatism that is now to be referred to is artificial, wrought by the surgeon, and is avoidable, and ought to be avoided. In not a few cases, bleeding may persist after the delivery of both child and placenta. This may be due, first, to the condition already discussed—namely, failure of the uterus to contract; secondly, to laceration of the cervix. This injury may occur under the natural expulsion of the fœtus; but it is much more likely to occur under the operations comprised under the term "*accouchement forcé*." Before the views of Robert Barnes prevailed the practice was to deliver at once; and this was often done without much regard to the fitness of the parts to undergo this severe proceeding. So imperious was the dogma of "unavoidable" persistent hemorrhage, that the difficulty presented by an undilated os uteri was met by the arbitrary hypothesis which assumes that, in these cases of flooding, the os uteri is, by the flooding, always made easily dilatable. Unfortunately this is not true. Proofs of laceration, of fatal traumatic hemorrhage from the injured cervix, and the penalty of forcing the hand through the presumed dilatable cervix, abound. But the error is still so prevalent that it is necessary to adduce evidence upon the subject. Leroux says (1810), that before Puzo's time the *accouchement forcé* was generally performed. The operation was difficult and often followed by a fatal issue. David Davis had met with many examples of even fatal hemorrhage unaccompanied by any amount of dilatation of the orifice of the womb. He relates a case where very profuse hemorrhage had occurred, yet the orifice of the womb was but very slightly dilated, and as rigid as if no hemorrhage had been sustained. Labor was induced, taking four or five hours to expand the os. Living twins were delivered. On the fifth day after labor profuse flooding set in, and caused death. No rupture was found; but the long-continued boring incident to the forcing of the hand had produced contusion, inflammation, and suppuration of the os uteri, and a portion of its tissue, of about the diameter of a sixpence, had sloughed off, and left behind it a deepish ulcer; several branches of arteries were found in the depth of it; and thus was rendered evident the cause of the fatal hemorrhage. The preparation is in Middlesex Hospital Museum.

Edward Rigby says:[1] "Cases have occurred where the os uteri has been artificially dilated, where the child was turned and delivered with perfect safety, and the uterus contracted into a hard ball; a continued dribbling of blood has remained after labor; the patient has gradually become exhausted, and at last died. On examination after death, Professor Naegelé has *invariably* found the os uteri more or less torn." Collins and others relate examples in point. The truth is, that so far from the os uteri in placenta prævia being in a state favorable to dilatation, the conditions are often the very reverse.

Tyler, of Dublin, relates a case in which traumatic tetanus followed upon placenta prævia.

Course and Symptoms of Placenta Prævia.

When the placenta grows wholly or in part within the lower zone, its relation to the uterine wall at this part is always liable to be disturbed. It is

[1] System of Midwifery, 1844.

most probable that some cases of presumed ordinary abortion at the third or fourth month are in reality due to this cause. We have seen (Bandl's, Fig. 84) that at the fourth month the distinctive characters of the lower zone are well marked. And we have frequently verified the fact, that in aborted ova of this period there was placental structure within the lower zone. But usually placenta prævia is not recognized as such earlier than the end of the fifth month. At and after this time the woman may be overtaken without warning by a smart flooding of florid blood. This often occurs when she is in bed at rest, even asleep. Probably, in some instances, the immediate cause is sexual intercourse. But certainly it is not necessary to invoke external physical agencies. Sometimes the woman is seized when she is out of doors or away from home, so little is she prepared for any accident. These attacks of hemorrhage are usually quite independent of labor or of uterine contraction. Even those who contend for contraction as the cause admit that the contractions are not felt (Spiegelberg). They occur most frequently at the menstrual epochs. Thus, it is not uncommon to observe a recurrence of these hemorrhages at intervals of about a month.

A strongly disposing cause is the greater hydrostatic tension in the vessels when the placenta is prævious, than is the case when the placenta grows to the fundus.

Sometimes it comes on after unusual fatigue or emotion. It cannot be doubted that the disturbance of relation between uterus and placenta is brought about by the increased afflux of blood brought to the uterus and placenta at these periods, and under the other influences specified. In the non-pregnant state, emotion alone causes hemorrhage.

Sometimes the bleeding subsides, and the patient is reprieved for a time. It is even possible that she may go on to the full term of gestation, after having suffered several attacks of hemorrhage, and be delivered naturally with little loss. But, most frequently, premature labor will be excited either at the first or at the second attack. The seventh and eighth months are especially critical epochs. The bleeding having begun, some blood is extravasated between the uterine and placental surfaces, the lower edge of the placenta gets thickened and hardened with extravasated blood, and thus the uterus is excited to contraction. When once the uterus is put in action, the termination in labor is highly probable.

The labor is often tedious, marked by inertia. The contractions are generally feeble. This is explained by the following circumstances: the defective muscular development of prematurity, especially of the lower segment; the disturbed polarity of the muscular action, there being diversion from the upper segment; the unfitness of the lower segment and cervix to expand, owing to immaturity and excessive vascularity.

Another explanation of the protraction is often found in the unfavorable position of the child. Transverse presentations are much more frequent than in ordinary labor at term.

The umbilical cord frequently falls through. For this there are two chief reasons: one is the abnormal presentation, which not filling the lower segment, allows the cord to drop through; the other is the frequent springing of the cord from the prævial margin of the placenta, so that a loop is ready to fall through the moment the os is sufficiently open and the bag bursts. A gush of liquor amnii washes the cord through.

In some cases of central placenta the child has been driven through the placenta, perforating it. This has been imitated in practice, the obstetrist perforating the placenta, and dragging the child through the hole. The part covering the os internum is sometimes thinned, and bare of placental structure.

Diagnosis.—If examination is made early during the flooding, the os uteri internum is often found scarcely, if at all, dilated more than is usual in pluriparæ—and it is in pluriparæ that placenta prævia most frequently occurs; but the cervix or vaginal portion is commonly thicker than ordinary. The finger, passed up to the os internum, will miss the head or other presenting part of the child, and thus *ballottement* will be obstructed or prevented, especially if the case be one of placenta centralis. In this case also *ballottement* may not be made out; but, instead, one feels the quaggy, spongy placenta or a blood-clot. The cervix is generally more tender to the touch, and pain is often felt, during gestation, at the lower segment of the uterus, and on the side to which the placenta grows. Levret says the uterus, instead of being rounded or pointed, is flattened, as if divided into two parts as in twin-pregnancy, but the division is more on one side, causing oblique singularity of form; and in the early months the patient has been conscious of a swelling with pain and hardness in one side. The stethoscope will, as McClintock and Hardy pointed out, often determine the seat of the placenta. Gendrin says a pulsation, not synchronous with the mother's pulse, may be felt at the os uteri. But these points are often difficult to realize.

Placenta prævia has to be differentiated from "accidental hemorrhage." It is usual to teach that in accidental hemorrhage the bleeding is arrested during a pain, whilst in placenta prævia the hemorrhage, although continuing during the intervals, is greatly increased during the pains. Nothing, we believe, can be more illusory than trusting to this distinction. As Legroux pointed out, the hemorrhagic act is diastolic; the *apparent* hemorrhage is systolic, the blood previously effused being expelled during the systole. The hæmostatic act it is which is systolic. Certainly, at the outset, there is often no pain in placenta prævia; and, as the case proceeds, active pains—that is, systolic contraction—will often stop the hemorrhage.

If there is active uterine contraction, even although considerable hemorrhage attend, and the cervix is expanding, the placenta or child being driven down, there is a fair prospect that Nature may carry the labor to a happy termination.

One great differentiating symptom consists in the appearance of the blood discharged. In placenta prævia it is commonly bright, arterial, whereas in accidental hemorrhage it is commonly black or more venous in appearance; and in the accidental form also there is often a serous, watery oozing, due to the squeezing out of the serum from the retained coagula. The seat and character of the pain are also different. In placenta prævia there may be little pain, and what there is mostly low down in the uterus, whilst in accidental hemorrhage the pain is almost always great; its seat is at the fundal or the equatorial zones, and in this seat of pain there is felt an irregular prominence on the surface of the uterus.

The only conclusive sign is feeling the placenta. Hemorrhage alone is fallacious; it may be due to other causes.

Some cases present great difficulty in diagnosis. The central cases in which the os internum is quite covered by placenta may be recognized by feeling the quaggy mass of placenta interposed between the finger and the fœtus. In cases of lateral placenta, in which a flap or edge of placenta grows down to the os internum on one side, this edge may occasionally be felt merging into the sac of the liquor amnii. But in another class of cases, which is more numerous, in which the placenta, although intruding within the lower zone, does not come within easy reach of the finger, the diagnosis must be mainly conjectural. Nothing is felt but the bag of membranes, and through it perhaps the fœtus. The reality of these cases is established after delivery of the placenta by observing the situation of the rent in the mem-

branes. If this is found within two or three inches of the margin of the placenta, we have distinct evidence that this margin is dipped into the lower zone. This is often confirmed by the appearance of the intruding lots of placenta near the rent. It is often thinner from compression and commonly filled with extravasated blood.

It is often repeated that partial placenta prævia is much less formidable than the placenta centralis. This may be so in some cases, but we are sure that no rule of prognosis or treatment can safely be based upon this assumption. Collins says in the grandest and most trustworthy of all collections of clinical records: "I have seen the hemorrhage as profuse when there was merely a portion of the edge detached as where the great bulk was separated." Our own experience entirely confirms this statement.

The prognosis as concerns the mother applies to three principal questions: 1. What is the immediate danger to the woman? 2. What is the remote or ultimate danger? 3. Will the case go on at once to the completion of delivery, or will the hemorrhage subside?

1. *The immediate danger to life* from loss of blood and shock is serious, if the hemorrhage be profuse, if the cervix remain unexpanded, and if contraction of the uterus and delivery be not secured within a short time. Whenever, then, the loss is rapid and great, telling upon the pulse, the indication is strong to abandon at once the prospect of postponing labor, and to proceed to accelerate delivery.

2. *The remote dangers*, supposing immediate sinking from hemorrhage is averted, arise from anæmia more or less directly. The secondary effects of hemorrhage are, malnutrition; nervous disorders; the local injury to the cervix uteri during labor; the contusion, laceration, dispose to secondary hemorrhage, the inflammation, and blood-infection from the necrosis of tissue about the mouths of the utero-placental vessels; absorption is enormously increased in activity after hemorrhage; phlegmasia dolens is not uncommon, and is sometimes of very severe type, being complicated with more than the ordinary degree of blood-infection; all the other forms of puerperal fever are more common after placenta prævia; and, lastly, there is the prospect of imperfect involution of the uterus, chronic metritis, perimetritis, and parametritis.

The implantation of the placenta upon the lower segment of the uterus involves an enormous increase of vascularity of the part, and this, added to the imperfect development attained when labor comes on prematurely, renders the dilatation of the cervix especially difficult and dangerous. The crushing, bruising, even laceration of the cervix, common to some extent even in ordinary labors, are much more to be dreaded in placenta prævia. Hemorrhage from laceration is not the only danger. One, a little more remote but scarcely less formidable, is that of inflammation, of pyæmia, or septicæmia. Some of the worst cases of puerperal fever we have seen were the direct consequence of the injury the highly vascular tissues of the cervix underwent from forcible delivery for placenta prævia.

Robert Lee records 6 cases of phlebitis out of 64 cases of placenta prævia.

In 1864 Robert Barnes reviewed his experience of the terminations in 69 cases. The deaths were 6—*i. e.*, 0.9 nearly. This proportion is much smaller than that usually given in statistical tables. But upon this it is idle to dwell, for general statistical tables drawn from miscellaneous sources are utterly untrustworthy in this matter. Of the six cases, one died three weeks after labor, of pyæmia; one died in a few days from pyæmia following forced delivery, performed by a surgeon who prided himself on his promptitude in the treatment of these cases; two were moribund from hemorrhage when first seen; one died of exhaustion (she had had eleven chil-

dren); one died of puerperal fever aggravated by brutal treatment from her husband. We have not been able to search our subsequent records. But we believe the results are not very different.

We feel very confident that if we could always see these cases at the earliest stage of hemorrhage, and if they were treated on the principles we have laid down, the mortality would be brought very much below anything hitherto known. In the cases above referred to there was a series of 29 successful cases uninterrupted by a single death. In 1884 we were summoned to 5 cases after hemorrhage had set in. All were treated after the method we have laid down. All the mothers and four children recovered.

3. *Will the case go on to delivery?* If the hemorrhage is moderate, if the os does not dilate, if there is little or no sign of uterine action, there is the probability of the utero-placental relations being so little disturbed that the pregnancy may go on, at least until the succeeding menstrual epoch. But this question is often practically settled by the physician, who, governed by his estimate of the strength of the patient, the stage of the gestation, and the urgency, absolute and relative, of the symptoms, may resolve to accelerate the labor. If the pregnancy have advanced beyond the seventh month, it will, as a general rule, be wise to proceed to deliver. The next hemorrhage may be fatal; we cannot foretell the time or the extent of its occurrence; and when it breaks out, all, perhaps, that we shall have the opportunity of doing will be to regret that we did not act when we had the chance.

The Prognosis as to the Child.—This will depend very much upon the conduct of the case.

In the event of the flooding and labor coming on before the seventh month, of course the prospect of the child being viable is small. The risk is also much above the average of ordinary labors, even when it takes place after the seventh month. The flooding may be attended with so much detachment of placenta that the supply may be cut off from the fœtus. Again, the imperfect development of the uterus may so retard or disorder the labor, that the child may perish before it can be born. Under any method of treatment formerly pursued, the risk was so great that Simpson and Churchill expressed the opinion that the hope of saving the child ought scarcely to influence the treatment. In this view we cannot concur; we are convinced that a judicious application of the principles we have laid down will result not alone in greater safety to the mother, but also in greater safety to the child. It is true that, in many cases, the child is dead before there is any opportunity for treatment. The child dies from asphyxia, the result of the mother's loss of blood. This blood, which is the means of aëration of the child's blood, comes in too small quantity and too much impaired in quality to effect the necessary change. Frequently, too, the child is, as we have seen, premature, or it presents unfavorably; frequently the cord is prolapsed, and then the child has to run the gauntlet of artificial modes of delivery. Exposed to these perils, it is not surprising that the child will often perish. But still the broad fact remains that a considerable proportion of children are born alive. It is certain that some of the sources of peril to the child may be lessened or averted. Out of 62 cases of placenta prævia which we noted in reference to this point, 23 children were born alive; and all the cases had been treated under favorable circumstances or in the most judicious manner.

We indulge the hope that a better result than this may be obtained if the proper principles are applied, starting from the onset of the flooding. The total artificial detachment of the placenta before the birth of the child is almost necessarily fatal to it. The precipitate forcible delivery is scarcely less hazardous to the child, and seriously imperils the mother. We are per-

suaded that the old method of treatment has killed more women and children than the disease.

The Treatment.

The treatment must vary according to the nature of the case; and cases of placenta prævia vary greatly. The course to be adopted will depend somewhat upon whether the presentation is central or lateral. But we think a more practical division is into—(A) cases, partial or complete, in which there is active contractile power in the uterus, with spontaneous dilatation; (B) cases in which the contractile power of the uterus is absent, with or without dilatation.

Before describing the principles and method of treating which we have worked out from theory deduced from observation, and crucially tested by clinical experience, it is useful to point out the methods commonly in vogue before the publication of Robert Barnes's Lumleian Lectures.

These methods flowed logically enough from the theories which successively prevailed. Thus—

1. The "unavoidable hemorrhage" theory, simple and absolute, dictated, as we have seen, immediate delivery, the "*accouchement forcé*." We have pointed out the fallacies of this theory, and the dangers attending the practice it dictated. What does the "*accouchement forcé*" mean? Literally and practically, it means violent delivery at all risks. The hand was *forced* through the cervix, dilated or not dilated; if not dilated, at the almost certain cost of severe injury to the uterus. This forcible entry accomplished, the child was then seized, turned, and extracted as promptly as possible. Its chance of survival was small, unless the cervix was so far dilated as to admit of easy and rapid delivery.

Spiegelberg proposed bilateral incision of the cervix, if it did not dilate. The proceeding is unnecessary and highly dangerous. Cutting the intensely vascular structure must expose to hemorrhage.

In some cases of central placenta it was advised to perforate the placenta and to deliver through the hole thus made. This method has been strongly —upon the whole, justly—condemned. But we have seen a few cases in which the placenta was so extensively diffused over the greater part of the uterus that there could have been no possible way of reaching a margin without passing the hand high up to the fundus. Concurring in the condemnation, we can imagine a case in which the practice of perforating the placenta might be excused.

2. The theory of Radford and Simpson, which, assuming that the hemorrhage came from the placenta, dictated the rule to detach the placenta wholly as early as possible. Some of the fallacies of this theory have been pointed out. The practice based upon it is open to serious objections. In the first place, it assumes that the probability of saving the child is so insignificant that it need not be considered. But we have seen that, under judicious management, a large proportion of children are saved. The operation consists in passing the hand, if necessary, into the vagina, then to pass two fingers through the cervix uteri, and with them to detach the placenta. This done, it was contended that Art had imitated Nature in those cases in which the placenta was cast spontaneously. The fallacy of this comparison and deduction has been already exposed. But Robert Barnes urged a fatal objection against this proceeding, showing that it was all but impracticable. In by far the greater number of cases the placenta extends higher than the equator of the uterus, sometimes even reaching the fundus. The fingers are not long enough to reach half way towards the further margin of the placenta.

The diameter of the placenta is rarely less than nine or ten inches; the fingers can hardly reach three or four inches. In the greater number of cases, therefore, in which the directions prescribed have been followed, the placenta has not been wholly detached; and the result, when successful, cannot be attributed to an operation which was not performed. This is further proved by the history of some of the cases narrated as examples of this practice. The child was born alive. It is hardly consistent with our knowledge of the conditions upon which the child's life depends to suppose that the child will survive if the whole placenta be detached, unless the birth follow the detachment very quickly. And this condition under the postulates of the hypothesis is wanting. This objection, so obvious when simply stated, was not suspected by Professor Simpson or his disciples until it was formally enunciated by Robert Barnes.

The entire detachment of the placenta has been urged on the ground that it can be executed at a stage when the dilatation of the cervix is insufficient to admit of turning. But if it cannot be executed without passing the hand through the undilated cervix, in what respect is the operation less severe than that of delivery by turning? It is reasonable to conclude that, since the forcible entry has been effected, the seizure and extraction of the child, as well as the detachment of the placenta, had better, in order to give the child a chance, be completed at the same time. This granted, the special character of the proceeding vanishes; it is even more severe than turning, which does not require the hand to be passed through the cervix.

In conclusion, we see that the surgeon endeavoring to practise complete detachment of the placenta by help of two fingers passed through the os uteri unconsciously, but almost *ex necessitate rei*, fails in what he tries to do; he unwittingly does very nearly what he ought to do. The hemorrhage stops; he sees in his success a proof of the truth of the theory that total detachment of the placenta is the security against hemorrhage. But he has not wholly detached the placenta; he has unconsciously given proof of the truth of a very different theory, namely, that the hemorrhage ceases when that part of the placenta which had grown within the lower polar zone has been detached.

Cohen's Method.—Cohen, of Hamburg, regarding the central placenta as being the condition of chief danger, advises to detach that smaller flap of placenta which passes over the os internum to the opposite side from the main body, thus reducing a central to a lateral placenta. This proceeding, fundamentally distinct in its theoretical argument and in its intrinsic nature, has been by some writers confounded with Barnes's method, to be presently described.

Barnes's Method.—The preceding discussion establishes the fundamental facts that hemorrhage can only be securely arrested by the contraction of the uterus, constringing the vessels, and favoring plugging of the vessels by thrombosis. All rational treatment must be based upon these facts. To obtain contraction is, therefore, the end to be sought. Although the powers of the system may still be good, the uterus will not always act well, especially when the labor is premature, whilst it is fully distended. To evoke contractile energy it is often enough to puncture the membranes. This done, some liquor amnii runs off; the uterus, collapsing, is excited to contract, and, being diminished in bulk, it acts at advantage. Labor being active, the cervix expands promptly, the placenta gets more quickly detached from the lower polar zone, the bared uterine vessels get closed by the retracting tissue and by the pressure of the advancing fœtus. The hemorrhage ceases spontaneously.

The successive steps to be adopted may be formulated as follows:

1. *The puncture of the membranes* is the first thing to be done in all cases of flooding before labor sufficient to cause anxiety. *It is the most generally efficacious remedy, and it can always be applied.* It is sometimes sufficient in itself; it does not materially interfere with the resort to further steps. The mode of executing it is: the patient lying on her left side, a finger is passed up into the os uteri, guiding a stilet, quill-pen, or a porcupine's quill to the membranes, whilst the uterus is supported by external pressure. This plan is especially useful in partial presentations; but even in central cases, if the cervix is not dilated, it may be resorted to by perforating the placenta. In these cases a long aspirator needle would be preferable.

Before puncturing the membranes pass the catheter. A full bladder is pretty sure to disturb or divert the natural contractile action of the uterus.

2. At the same time *apply a firm binder over the uterus.* This further promotes contraction, and, by propelling the child towards the os uteri, it accelerates the expansion of the os and moderates the hemorrhage.

3. If the hemorrhage continue, especially if the patient show signs of exhaustion, the os uteri being undilated, the *plug may be tried.* Lerour, Dubois, Chailly, and many other authorities extol the plug. What has usually been understood as plugging consists in ramming soft substances into the vagina. *Vaginal plugging:* The things used are silk handkerchiefs, tow, lint, bandages, and *Braun's colpeurynter.* This last is an elastic bag, which may be distended with air or water. As its name implies, it is a vaginal plug. Vaginal plugs are treacherous aids, requiring the most vigilant watching. The plug, introduced with so much pain to the patient, soon becomes compressed, blood runs past it or accumulates above or around it, and the tide of life ebbs away unsuspected. Never leave the patient trusting to vaginal plugs. Feel her pulse frequently, watch her face closely, examine to see if any blood or tinged serum is oozing externally. Remove the plug in an hour at furthest, and feel if the os uteri is dilating. If it be dilating and the hemorrhage have stopped, you may trust Nature a little further, watching closely. The labor may now go on spontaneously, perhaps issuing in the birth of a living child.

But the true way of plugging is to insert sponge or laminaria tents into the cervix uteri. This is the part that needs to be dilated. The tents command this effect by direct stretching, and by exciting diastaltic action.

Whenever plugging is resorted to, use especial care in watching the state of the bladder. Partly by direct pressure upon the urethra, and partly by diverted or "metastatic" nervous energy, plugging is apt to cause retention of urine.

4. Expectancy has its limits. This is determined by the continuance of the hemorrhage and the condition of the patient. The question of resort to the *accouchement forcé* presents itself perhaps imperiously to the mind. But there are two means of accomplishing the end in view without violence, with more certainty, and with more safety to the patient and her child. The uterus must be placed in a condition to contract. The essential steps towards this end are, first, the free dilatation of the cervix; secondly, the completion of the labor.

The first difficulty is to *effect the dilatation of the cervix.* Under any process this must take a little time. Can anything be done in the meantime to moderate the bleeding? Something very effectual may be done. *Separate all the placenta which adheres within the lower zone.* We shall thus get over the stage of danger more quickly. We remove an obstacle to the dilatation of the cervix, for the adherent placenta acts as a mechanical hindrance to the retraction of the lower segment of the uterus; we lessen the

risk of laceration of the placenta, an accident very likely to happen in the ordinary course and under turning, and which by rupturing the fœtal vessels, adds to the peril of the child.

The operation of detaching the placenta from its adhesion to the lower polar zone is as follows: Pass one or two fingers as far as they will go through the os uteri, the hand being passed into the vagina if necessary; feeling the placenta, insinuate the finger between it and the uterine wall, sweep the finger round in a circle so as to separate the placenta as far as the finger will reach. If you feel the edge of the placenta where the membranes begin, tear open the membranes freely, especially if these have not been previously ruptured; ascertain if you can what is the presentation of the child before withdrawing your hand. Commonly some amount of retraction of the lower zone and opening of the cervix takes place after this operation, and *often the hemorrhage ceases.* Time has been gained. The patient has the precious opportunity of rallying from the shock of previous hemorrhage and of gathering up strength for further proceedings.

If, the cervix being now liberated, under the pressure of a firm binder, ergot or stimulants, uterine action returns so as to drive down the head, it is pretty certain there will be no more hemorrhage. The head acts as a plug from above, compressing the bare surface of the uterus. You may leave Nature to expand the surface and complete the delivery. The labor, freed from the placental complication, is resolved into natural labor.

5. If, on the other hand, the uterus continue inert, the hemorrhage may not stop, and we must proceed to the next step, *the artificial dilatation of the cervix.* This is accomplished by the use of Barnes's hydrostatic dilators. Insert the largest size that will pass through the cervix; distend with water gently and gradually, watching by the finger the effect of the eccentric strain upon the ring of the os externum. When the bag is fully distended, keep it *in situ* for half an hour, or an hour if necessary. During this time the hemorrhage is commonly suspended; probably the intrauterine portion of the bag presses upon the mouth of the bared vessels; certainly retraction or shortening of the lower segment of the uterus goes on, which is the direct means of closing these vessels; and under the combined effect of pressure from below by the dilator and from above by the binder, the contents of the uterus are kept in close contact with its inner surface, thus maintaining pressure on the vessels of the cervix, and stimulating the whole organ to contract. Legroux, guided by the observation that hemorrhage occurs during uterine diastole puts the patient in the vertical position during uterine relaxation, so as to keep up the pressure of the contents of the uterus upon the cervix. He relates a case in which this practice perfectly succeeded. But it is obvious that the upright posture adds to the danger of syncope. The bags accomplish the purpose better and more safely. When the cervix is freely open the bag may be withdrawn.

Again we may pause and observe if Nature is able to carry on the work. If contraction persist, if the head present, the labor is now essentially normal, and may be allowed to go on without interference. But we must watch closely.

6. If contraction is inefficient, if hemorrhage goes on, if another part than the head present, we must carry our help further. We must do what Nature cannot do; *we must deliver.* If the head present, it is generally best to put on the forceps, then pulling gently in the axis of uterus and pelvis, keep the head upon the os uteri for awhile, until it is felt that the expansion is sufficient to permit it to pass without undue force.

If the shoulder or breech present, we deliver by seizing the nearest leg and extracting. This can almost always be done without passing the hand into

the uterus. Braxton Hicks's bimanual operation here finds one of its most useful applications. It avoids the danger of forcing the hand through an imperfectly developed, imperfectly expanded cervix, and abnormally vascular structure. Having seized a leg, it must be drawn down gently, so as to bring the half-breech into the cervix. Axial traction must be so regulated as to bring the trunk through with the least amount of force. Whilst delivery is going on, the hemorrhage is generally arrested. Rapid extraction involves a certain amount of violence and shock. Gentle extraction, giving the cervix time to dilate gradually, avoids this evil.

7. As soon as the child is born, readjust the pressure upon the uterus; and, if there is no hemorrhage, allow three or four minutes for the system to rally before attempting to remove the placenta. If hemorrhage occur, and the placenta does not pass on fair compression of the uterus and traction on the cord, the hand must be passed into the uterus to detach it. The portion growing to the equatorial zone is not always readily cast. Examine the placenta carefully on its uterine surface to see if it is entire.

In every labor the cervix, having to suffer great distention and contusion under the passage of the child, and possessing less contractile elements in its structure, is liable to paralysis for a time. This condition is more likely to occur in labor with placenta prævia, and it is doubly dangerous because the cervix is so near the placental seat. Here is another reason for sparing the cervix to the utmost.

The history and management of hemorrhage after the completion of labor, complicated with placenta prævia, merge into the conditions of post-partum hemorrhage generally; the special point to remember being that the after-hemorrhages of placenta prævia are likely to be even more urgent, and thus to require more vigilance and more resolute treatment.

The chief facts in relation to placenta prævia may be summed up in the following series of physiological and pathological propositions. Abounding clinical observations recorded by ourselves and others attest their truth.

A. *Series of Physiological Propositions.*

1. The hemorrhage comes mainly from the bared uterine surface, and is arterial.

2. In the progress of many labors with placenta prævia, there is a period or stage when the flooding becomes spontaneously arrested.

3. This hæmostatic process does not depend upon total detachment of the placenta, nor upon death of the child, nor upon syncope of the mother, nor upon pressure upon the lower segment of the uterus bared of placenta, although one or more of these conditions may favor it.

4. The one constant condition of this physiological arrest of the flooding is contraction of the uterus, active or tonic.

5. This physiological arrest of flooding is neither permanent nor secure until the whole of that portion of the placenta which had adhered within the lower zone is detached, this being the portion which is liable to be separated during the opening of the lower segment of the uterus to the extent necessary to give passage to the child. The limit of dangerous placental attachment corresponds to the equator of the child's head. Below this, the circle so indicated, the lower segment must dilate; above this circle the placental attachment is normal, and need not expand. This physiological boundary line is identical with Bandl's ring.

6. When this stage of detachment has been reached, there is no physiological reason why any further detachment or flooding should take place until after the expulsion of the child, when, and not till then, the remainder

ıe placenta which adheres to the middle and fundal zones of the uterus
ıt off, as in normal labor.

Adhesion of the placenta over the os uteri internum impedes the regular
ation of the part; and, consequently, whilst such adhesion lasts, the
rly course of labor is hindered.

Injury and inflammation of the uterine structures, particularly of the
ix, are especially likely to supervene upon delivery in placenta prævia.
of the purposes intended by Nature in fixing the seat of the placenta
ıe fundal and equatorial zones is the preservation of the parts, rendered
ly vascular by connection with the placenta, from the distention,
ıure, and contusion attending the passage of the child.

B. *Series of Therapeutical Propositions.*

The greatest amount of flooding frequently takes place at the com-
cement of labor, and frequently even before there is any clear indication
ıbor. The cervix is always, from its being near the seat of the pla-
al attachment, highly vascular, and is frequently at this stage very rigid.
attempts to force the hand through this structure at this stage, to de-
the whole placenta or to deliver, must be made at the risk of injuring
womb. The dragging the child through the cervix when in this condi-
even when it has not been necessary to pass the hand into the uterus,
proceeding affording slender chance of life to the child, and fraught
danger to the mother.

The entire detachment of the placenta is not necessary, and is not to
ɜpended upon, to insure the arrest of the hemorrhage.

Since the dilatation of the cervical portion of the womb must take
ɜ in order to give passage to the child, and since, during the earlier
ɜs of this necessary dilatation, hemorrhage is liable to occur, it is desir-
to expedite this stage of labor as much as possible.

In cases where labor appears imminent, with considerable hemorrhage,
ɜt the os internum uteri is still closed, the arrest of the flooding and the
nsion of the os may be promoted by plugging the vagina, especially the
x, and by the use of ergot.

Since a cross-presentation or other unfavorable position of the child at
ɜs internum is apt to impede or destroy the regular contractions of the
ıs, which are necessary to arrest the flooding, it is mostly desirable to
ɜr as soon as the condition of the os uteri will permit.

In some cases the simple use of means to excite contraction of the
ıs, such as ergot, rupturing the membranes, or the employment of gal-
sm, may suffice to arrest the hemorrhage.

In some cases in which it is observed that the os uteri has moderately
ınded—namely, to a diameter of 1.25 in., or 4 cm.—the placenta being
to be detached from the lower zone, and the hemorrhage having ceased,
not necessary to interfere with the course of the labor, now become
ıal.

At the critical period, when the total detachment of the placenta or
ible delivery is dangerous or impracticable, the introduction of the index
ɜr through the os, and the artificial separation of that portion of the pla-
a which lies within the lower zone of the uterus, is a practicable and
operation.

The artificial detachment of that portion of the placenta which adheres
ıin the lower zone will at once liberate the os internum from those
chments which impede its equable dilatation, and, by facilitating the
ılar contraction of this segment of the uterus, favor the arrest of hemor-

rhage, and convert a labor complicated with placenta prævia into a natural labor.

10. The immature uterus, partly paralyzed by loss of blood, cannot always be trusted to assume the vigorous action necessary to effect delivery; it is, therefore, often desirable to aid by dilating the cervix artificially; this can be done safely and quickly by the caoutchouc water-dilators.

11. Sufficient dilatation being attained, delivery may, if necessary, be accelerated by forceps, turning, or craniotomy, according to the special indications afforded by the condition of the child.

Post-partum Hemorrhages.

It is convenient to include under the title *post-partum hemorrhage* all the hemorrhages which occur from the birth of the child, and during the succeeding twenty-four hours. These latter may be further distinguished as *primary post-partum* hemorrhages.

But hemorrhages may occur after this period, and at any time for a month or more. These may be distinguished as "*puerperal hemorrhages*," or as *secondary post-partum hemorrhages*.

It is difficult to draw a strict physiological line between these two. But an arbitrary line thus drawn has a clinical value. Theoretically, the distinction may be stated thus: That is primary post-partum hemorrhage which takes place whilst the uterus, recently disburdened, still retains its muscular fibre unaltered. At the end of twenty-four hours, or nearly, the involution-process has generally begun; from this time is the period of secondary hemorrhages.

In practice, we have to prevent or to treat (*a*) hemorrhages whilst the placenta is retained; (*b*) hemorrhages persisting or breaking out after the placenta is removed. These two constitute primary hemorrhage; and primary hemorrhages may be usefully subdivided into (1) *immediate*, and (2) those which occur later, from the uterus relaxing again after apparent firm contraction had been attained. These may be called *paulo-post-partum* hemorrhages. (*c*) Hemorrhages which persist or break out after twenty-four hours from childbirth. These constitute *secondary* hemorrhages.

(*a*) The hemorrhages which break out before the removal of the placenta have been discussed in the chapter on the management of the after-birth stage of labor.

(*b*) Although in most cases flooding will cease when the after-birth has come away, still it not seldom happens that flooding will persist or break out afterwards. Many of the causes which lead to hemorrhage during the after-birth period may continue to act after the placenta is removed. Almost all these causes have for one important effect to impair the contractile energy of the uterus.

The causes of primary post-partum hemorrhage may be divided into two classes: (1) those antecedent to the labor; (2) those which arise during and after the labor.

The first order of causes often lie deep in constitutional peculiarities. Foremost amongst these is the mysterious *hemorrhagic diathesis*. Some women are by nature "bleeders." All through pregnancy and labor these women are likely to be the subjects of hemorrhage. Under the peculiar conditions of the blood, of the vascular apparatus, and other special conditions, the hemorrhagic diathesis is pretty sure to assert itself.

Other remote antecedent or predisposing causes have been described in the chapters on the physiology and pathology of gestation; we may recall

some of the principal causes. Albuminuria has been shown by Blot and Chantreuil to be a potent predisposing cause. The correlated condition of the blood is, in fact, constantly favoring extravasation at the weak points of the utero-placental vascular system. Then there are spamenia, leucocythemia, hepatic sluggishness or obstruction, some diseases of the heart and lungs. Cullen insisted forcibly on the evil influences of alcoholism. "All our drunkards," he said, "have their blood more fluid than natural, and are liable to hemorrhages." Again, delicately nurtured women, who have cultivated the emotional element at the expense of physical development, are especially prone to disordered labor, to hemorrhage, and the other accidents of childbirth. In such women there is a want of due relation between nervous and muscular power.

2. *The Immediate Causes, or those arising during Labor.*

The main security against hemorrhage lies in the orderly course of labor. If the labor be so conducted as not to disturb the due sequence and correlation of the acts which govern the labor, the risk of hemorrhage will be small. But, true as this aphorism is, we are not hastily to conclude that the preservation of this orderly sequence is always in the power of the physician. In the case of healthy women, no disturbing cause intervening, the labor proceeds in due order, if only the physician will abstain from interference. But in not a few cases of healthy women, as in many who are not healthy, adverse conditions have existed before, or arise during the labor, which there has been no opportunity to obviate. The physician has to deal with them as he finds them, doing his best to remove them or to overcome them. Under the combined action of these adverse conditions and of the treatment required, the normal sequence and correlation of the parturient forces are unavoidably disordered; hence hemorrhage.

Amongst the most efficient causes of this class are: Anæsthesia, induced by chloroform or ether; emotion; lingering labor, especially when artificial intervention is required, as from malposition, or malproportion; hemorrhage during the first and second stages; premature rupture of the membranes; injudicious voluntary efforts, as forcible bearing-down whilst holding on a towel tied to the bedpost. Voluntary efforts in aid of labor should wait upon the involuntary reflex effort. If made independently, they wear out the nervous power and impede rather than help the reflex work. Protracted labors, labors with plural births in which the placental area is doubled, whilst the muscular power is weakened, are especially apt to entail hemorrhage. Undue haste in extracting the placenta, retention of urine, retroflexion of the uterus, fibroid tumors or polypus strongly dispose to hemorrhage.

Hemorrhage after the removal of the placenta may proceed from the following *sources:* (1) from the bared placental site; (2) from laceration of the cervix uteri; (3) from injury to the vagina or vulva, as from thrombus or laceration.

The treatment of hemorrhage—prophylactic, arrestive, and restorative—must be based upon a rational study of the phenomena which precede and accompany it—that is, upon the physiological history of pregnancy and labor.

What are the means which Nature employs to prevent and to arrest hemorrhage?

1. The first is *active contraction of the muscular wall of the uterus.* The contracting muscular fibres surrounding the arterial and venous canals close them tightly in proportion to the vigor of the contraction. To obtain this

contraction is the great aim of the obstetrist. To many it is the only aim being ignorant of or distrustful of the value of any other. In this they fall below the level of physiological law, which has yet other resources.

At first this contraction is rhythmical, partly peristaltic and partly reflex. But presently, active contraction settles into passive or *tonic* contraction, by which the volume of the uterus is permanently reduced. This resembles *elastic* contraction, and has been likened by Leroux to a spring (*ressort*). When this tonic contraction has been established, the patient is secure against a return of hemorrhage—unless, indeed, we except the "peculiar form of hemorrhage" described by Gooch. This keen observer, admitting that "contraction prevents hemorrhage by occasioning a sufficient closure of the vessels to resist the ordinary force of the circulation," supposes that if the force of the circulation be extraordinarily great, it would be able to overcome the ordinary closure of the vessels. He gives a striking case in illustration. The patient showed marked fulness—or, as we now express it, high tension of the vessels—before labor.

2. *The Uterine Arteries have a Certain Retractile Property.*—Shrink in inwards when severed, their mouths become narrowed, and the formation of *thrombi* is favored. Marey also showed that the arteries shrink generally, their calibre lessening. Hales, first by experiments, showed that abundant hemorrhage lowers arterial tension; that on reinjecting blood tension rose again. But it also depends upon the duration of the subtraction or of the injection of blood, for the arterial system, if distended suddenly, quickly throws into the veins the excess of blood received. Inversely, if the arteries have sustained a rapid subtraction of blood, they quickly repair the loss by calling upon the venous system.

Thus there is accommodation under hemorrhage. If the vessels fill, accommodation is by relaxation of the vessels; if there is hemorrhage, there is accommodation by contraction.

3. When the nutritive developmental attraction of blood to the uterus is suddenly cut short by the separation of the child and placenta, there ensues an equally sudden diversion or raptus of the blood-current away from the uterus into the general or systemic circulation. In this diversion lies an effective security against hemorrhage. An illustration of this is seen in the counterpart or correlative diversion of blood from the umbilical arteries of the child when the placental connection with the uterus is cut off. The two circulations, maternal and fœtal, hitherto irresistibly drawn to meet at one focus, the one to bring life-elements, the other to seek them, at once turn aside into different routes as soon as the life of the child is secured by independent means. Thus, blood no longer running into the uterine arteries, stagnation follows, and hence another provision for plugging the vessels by clotting.

Robert Ferguson dwelt much upon coagulation as a security. "It appears," he says, "to be the sole means of safety in those cases of intense flooding in which the uterus flaps about the hand like a wet towel. Incapable of contraction for hours, yet ceasing to ooze out a drop of blood, there is nothing apparently between life and death but a few soft coagula plugging up the sinuses."

4. This diversion of blood from the uterus, and clotting of blood in the uterine vessels, is further promoted by the rapid lowering of the nervous and vascular tension which follows delivery. The heart beats less forcibly; the impetus of blood in the aorta is diminished.

5. A special hæmostatic property is found in the blood itself. The ordinary blood of pregnant women contains more fibrine than is found in non-pregnant women; and Andral demonstrated that the proportion of fibrine,

and hence the coagulability of the blood, increased with the quantity of blood lost.

6. Then another resource Nature still holds in reserve, and that is the temporary lowering, approaching to suspension, of the heart's action under syncope. Under this state coagulation in the uterine vessels is further favored, so that when the heart resumes its action the vessels are closed. The situation is perilous in the extreme; life trembles in the balance; the slightest shock, further loss of blood, ever so small, may turn the scale against hope.

It is in the careful clinical study of all these conditions, excepting the last, separately and in their solidarity, that we must seek indications for treatment. In a typical labor, all these conditions are factors of one great conservative process. They are indissolubly associated, coming into play simultaneously or nearly so, and if one factor fails, especially contraction, the rest also commonly fail.

The most constant phenomenon in hemorrhage is loss of contraction of the uterus. This is recognized under the terms *atony, inertia, paralysis.* Temporary paralysis is the best term. The paralysis is duplex; there is failure of centric nerve-force, so that there is imperfect action of the diastaltic function; there is failure of the uterine inherent contractility dependent upon its proper ganglionic nervous system.

When the uterus relaxes, after having been contracted, one thing follows. The expansion of the uterine walls opens up the vascular channels in their substance, and thus exerting a suction-force, blood is drawn into them from the arterial system certainly, and probably also from the venous system. When contraction comes, part of this blood may be driven into the systemic vessels, but the greater part is discharged into the uterus and is lost as hemorrhage. This process being repeated, the blood is thus, by a scarcely exaggerated figure of speech, pumped out of the body. Often, again, emotion, the dread of flooding, taking off the inhibitive action, determines blood to the uterus and adds force to the local hemorrhagic factors.

The immediate general effects of bleeding are: 1. To disturb the balance between the circulating and respiratory systems. 2. To promote the influx of fluids from all parts of the body into the venous system. 3. To promote the tendency to the separation of fibrine. 4. Syncope. 5. Convulsion of the muscles from the removal of nervous control, muscular irritability being retained. 6. Fall of animal temperature.

The Symptoms, Diagnosis, and Prognosis of Hemorrhage from the Uterus.—The first warning often is the complaint of the patient that she feels blood flowing from her. This should never be disregarded. Examine the parts and the linen immediately. You will often see a thin stream of florid blood trickling down. You feel for the uterus, and find that it rises above the pubes, perhaps above the umbilicus—that it is flaccid, or presents irregular, hard prominences which shift their position under your grasp. On compressing the fundus firmly, blood and clots may be forced out of the vagina. If the uterus is not brought to contract by the usual means, you pass your hand into the cavity, and feel that it is full of blood partly clotted; you feel the enlarged cavity; you feel the flabby walls. When the inertia is complete, it is sometimes difficult, by external manipulation, to make out the uterus at all. You miss the hard globe, and this negative sign is all. When the uterus has reached its full measure of distention, spasmodic contraction is sometimes excited, and a furious rush of blood is poured forth. Alternate contractions and relaxations, pain attending, and tenderness on grasping are certain signs of hemorrhage from atony. Blood may issue in a considerable stream, or by gushes mixed with loose clots. Or it may simply

ooze in a thin stream; in this case the discharge is often watery. A watery discharge tinged with blood, if occurring immediately after the expulsion of the placenta, may sometimes be liquor amnii; but if occurring at other times, and in connection with signs of general depression, it indicates internal hemorrhage, with retention of clot, the serous element being squeezed out and flowing externally. These are the *local signs*.

The *general signs* are scarcely less marked. Bleeding often goes on insidiously, the woman not complaining. But this calm may be illusory. In extreme cases a degree of shock, of collapse, is conspicuous; the face is pale, white, waxy, and cold; the whole surface is cold, the pulse is frequent, feeble, thready, sometimes not to be felt. Hales established that the pulse became more frequent by hemorrhage. Marey showed that, at the same time, there was feeble tension (see Fig. 157). The sudden penetration of blood in the arteries swells the fulness of the pulsation and causes *dicrotism*. This is the more marked in proportion to the rapidity of the loss.

FIG. 157.

SPHYGMOGRAM OF A CASE OF POST-PARTUM HEMORRHAGE. (FANCOURT BARNES.)

If hemorrhage is very abundant, a contraction of vessels is produced which restores tension, and causes disappearance of the increase of fulness of pulse, more especially since the radial, like all arteries, undergoes a diminution of calibre, which by itself would render the pulsations weaker. It is this kind of shrinking of the vessels which J. Hunter observed in animals bled to death, which led him to the discovery of the contractility of the arteries.

There is an indescribable sense of oppression in the chest. The woman calls out for air, will have the windows open, insists upon sitting up, sometimes would even get out of bed; the respirations rise to 30, 36, or even to 40 in the minute, they are laborious; she tosses her arms about, says "she is sinking through the bed;" is more or less delirious; her perception of external objects is often dulled, or her appreciation of them is distorted; partial blindness, double vision, sometimes complete amaurosis set in, the pupils dilate, the iris seems paralyzed; she ceases at times to recognize the people about her; she complains of intense headache, noises in the ears, sometimes is deaf; she can hardly swallow, unless the fluid be poured into the back of the mouth. So great is the loss of nerve-power that every organ seems paralyzed. Brandy, beef-tea, medicines lie inert in the stomach, until rejected by vomiting. The uterus refuses to act under any stimulant; perhaps the sphincters relax, feces and urine being voided. The woman rejects help; by word or sign entreats to be let alone; she would willingly die undisturbed. From this state, desperate as it seems, she may recover. If the bleeding stop for awhile, slowly there is gathered up a little nerve-force; life that seemed ready to flit, holds its seat, feebly, it is true, and if no fresh loss or shock occurs, she may rally.

But if these signs are followed by marked collapse, contracting features, short gasps, sighing or sobbing inspirations, which indicate that the chest-walls are unable to expand and make but an imperfect attempt to take in air, then quickly collapse; and if convulsive movements occur, the case is

of the placenta which adheres to the middle and fundal zones of the uterus is cast off, as in normal labor.

7. Adhesion of the placenta over the os uteri internum impedes the regular dilatation of the part; and, consequently, whilst such adhesion lasts, the orderly course of labor is hindered.

8. Injury and inflammation of the uterine structures, particularly of the cervix, are especially likely to supervene upon delivery in placenta prævia. One of the purposes intended by Nature in fixing the seat of the placenta in the fundal and equatorial zones is the preservation of the parts, rendered highly vascular by connection with the placenta, from the distention, pressure, and contusion attending the passage of the child.

B. *Series of Therapeutical Propositions.*

1. The greatest amount of flooding frequently takes place at the commencement of labor, and frequently even before there is any clear indication of labor. The cervix is always, from its being near the seat of the placental attachment, highly vascular, and is frequently at this stage very rigid. Any attempts to force the hand through this structure at this stage, to detach the whole placenta or to deliver, must be made at the risk of injuring the womb. The dragging the child through the cervix when in this condition, even when it has not been necessary to pass the hand into the uterus, is a proceeding affording slender chance of life to the child, and fraught with danger to the mother.

2. The entire detachment of the placenta is not necessary, and is not to be depended upon, to insure the arrest of the hemorrhage.

3. Since the dilatation of the cervical portion of the womb must take place in order to give passage to the child, and since, during the earlier stages of this necessary dilatation, hemorrhage is liable to occur, it is desirable to expedite this stage of labor as much as possible.

4. In cases where labor appears imminent, with considerable hemorrhage, whilst the os internum uteri is still closed, the arrest of the flooding and the expansion of the os may be promoted by plugging the vagina, especially the cervix, and by the use of ergot.

5. Since a cross-presentation or other unfavorable position of the child at the os internum is apt to impede or destroy the regular contractions of the uterus, which are necessary to arrest the flooding, it is mostly desirable to deliver as soon as the condition of the os uteri will permit.

6. In some cases the simple use of means to excite contraction of the uterus, such as ergot, rupturing the membranes, or the employment of galvanism, may suffice to arrest the hemorrhage.

7. In some cases in which it is observed that the os uteri has moderately expanded—namely, to a diameter of 1.25 in., or 4 cm.—the placenta being felt to be detached from the lower zone, and the hemorrhage having ceased, it is not necessary to interfere with the course of the labor, now become normal.

8. At the critical period, when the total detachment of the placenta or forcible delivery is dangerous or impracticable, the introduction of the index finger through the os, and the artificial separation of that portion of the placenta which lies within the lower zone of the uterus, is a practicable and safe operation.

9. The artificial detachment of that portion of the placenta which adheres within the lower zone will at once liberate the os internum from those attachments which impede its equable dilatation, and, by facilitating the regular contraction of this segment of the uterus, favor the arrest of hemor-

We can bear testimony to its use, but it is difficult to administer it in t way. It might be usefully injected into the uterus.

In severe cases, ergotine may be injected subcutaneously.

In *the second degree* the difficulties are increased. The diastaltic funct is weakened. It must be coaxed, not overridden. Ergot, quinine, digit may still be useful. But it cannot be too emphatically declared that er is incapable of giving strength to the spinal centre; that it can only stin late it, just as whip and spur goad the jaded horse. If pushed beyon moderate degree, ergot then only tends to depress, to exhaust. Hence it not rare to see its use, in the conditions described, followed by vomiti spasmodic action of the uterus, and even by sensible depression of the he The rule should be: give ergot early after the expulsion of the child, wh hemorrhage is apprehended; repeat it as soon as hemorrhage declares its but, if it fails to act promptly, give no more. We must turn to surer mea

Direct compression of the uterus acts in two ways: first, by mechanica closing the vessels; secondly, by exciting diastaltic contraction.

The uterus may be compressed in several ways:

1. By grasping the uterus through the abdominal wall. 2. By press it strongly back against the spinal column, the patient lying on her ba This acts, also, by compressing the aorta. Ploucquet compressed the ao against the spine. This was adopted by Baudelocque, Chailly, Caseaux, a others. 3. G. Hamilton[1] advised the following: The fingers of one ha introduced into the vagina are placed under the uterus; then, with the ot hand upon the uterus externally, the organ is firmly compressed betw the two hands. The cavity is thus closed by the anterior and posterior s faces being flattened together. It is an excellent plan. 4. Gooch's pl Gooch passed a hand into the uterus, and, applying it to the placental s compressed the wall between the hand inside and the hand outside. T plan is no doubt effectual, but it is not so good as Hamilton's. The int duction of the hand into the uterus is not free from danger. It has b fatal.

Compression of the uterus, skilfully performed, checks bleeding, and gi time to rally strength and for the administration of restorative remedies alcohol, ether, ammonia, cinnamon. Thus the diastaltic force may be stored. *Cold* may help. A lump of ice may be applied to the belly, to vulva, inside the vagina, or, better still, as Levret did, inside the ute But it is essential to know that, in severe cases, cold may be hurtful. Bl ing, we know, reduces the body-temperature. Under the loss of bala between the respiratory and circulatory systems and the diminished volu of blood, the animal heat is with difficulty maintained. Cold, artificia applied, therefore, adds to the depression. Physiological and clinical ob vations thus alike urge extreme caution in the use of cold. It is the age of all others, most abused. We have seen many cases of metritis and pu peral fever which we could trace to no other cause than the abuse of c and wet and kneading. Bence Jones and Dickinson[2] found that c douches lowered the pulse. Breathing cold air has the like effect. He raises the pulse.

The rule as to cold, then, should be like that as to ergot. If it fail to a promptly, give it up. Now, the indication is clear to economize the nervo energy, trying to reawaken the diastaltic function by *heat*. This is done b applying hot bottles or flannels to the skin, by injecting water at 100° F to 110° F. into the uterus.

[1] Edinburgh Medical Journal, 1861.
[2] Journal of Physiology, vol. i.

The uterine tube is carried fairly into the uterus, and a current is gently propelled during a minute. Carbolic acid, in the proportion of one per cent., may be usefully added. Besides its antiseptic action, I have observed that it exercises some astringent action. A better thing still is probably a solution 1 in 2000 of corrosive sublimate. If the hot water fail, it may be useful to alternate with an injection of iced water. During this manœuvre the hand should maintain compression of the uterus. And in combination with this the aorta may be compressed. The patient is on her back. The uterus grasped in both hands, part of one hand presses the aorta against the left side of the spinal column. Kiwisch, Hohl, Boër, object that pure compression of the aorta on Ploucquet's plan is not effective, that the blood goes round by the spermatic arteries, and that the real good is due to compression of the uterus. It ought certainly not to supersede compression of the uterus.

If the uterus still refuse to contract, things are lapsing into the *third degree*, in which the diastaltic function is in abeyance. It may return if the hemorrhage can be stopped for awhile. In the meantime we must appeal to other factors which nature holds in reserve. She may answer to an appeal made to the *vis insita*, that essential contractility which the uterus preserves for some time independently of the spinal centre. The interior of the uterus may shrink under styptic applications; the mouths of the vessels may be blocked by coagula. We may then gain respite enough to resort to restorative measures, and thus to allow muscular contraction to return.

Of the remedies that now present themselves, the most scientific is *Faradization*. The experiments of Radford, Robert Barnes, and Mackenzie, demonstrate that, under this power, the uterus can be made to contract, even when it resists the influence of what may be called the diastaltic remedies. We used it assiduously on many occasions, sometimes succeeding in inducing permanent contraction, sometimes not. Practical objections prevailed with us to give it up. Except in hospital practice, the apparatus is not likely to be ready on the emergencies that call for action; for the most part the contractions induced were transitory, ceasing when the circuit was broken, and whilst using it the more valuable compression of the hand had to be abandoned. Private reports inform us, however, that it acts satisfactorily. Dr. Kilner adduced strong evidence in its favor before the Obstetrical Society, 1884. We would, therefore, encourage further trials.

Failing, then, to induce muscular contraction of the uterus, we are driven to choose agents that corrugate the inner wall of the uterus, and thus close the gaping mouths of the vessels. This corrugation, if not a perfect equivalent to contraction, for the time answers the immediate object of stopping the hemorrhage.

It is often useful to reanimate the patient before resorting to manipulative proceedings. In extreme debility, the absorptive power of the stomach is lost; stimulants swallowed are soon rejected, or if retained for awhile are not absorbed. The most excellent plan is to inject a drachm of sulphuric ether under the skin. The rallying effect of this is sometimes surprising. It may be repeated, if necessary, several times.

Practically there are *two stypties* which claim attention: *iodine* and *iron*. The older authors give accounts of vinegar, lemon-juice, and other agents having been used as injections, or by plugs soaked with the styptic. Smellie says: "The vagina may be filled with tow or rags dipped in vinegar in which a little alum or saccharum saturni hath been dissolved; nay, some inject proof spirits warmed, or, soaking them up in a rag or sponge, introduce or squeeze them in the uterus to constringe the vessels." But all these things fell into disuse.

Hohl says injection of perchloride of iron was first used by D'Outrepont.[1] Kiwisch warmly praised it. Professor Faye, of Christiania, says (1874) that he has used it in his maternity since D'Outrepont's time. Still it remained practically neglected on the continent, and quite unknown in this country until Robert Barnes introduced it. In the Lettsomian lectures on placenta prævia (1857), after a fair amount of experience, he recommended the practice. In publishing the "Obstetric Operations" he felt strengthened in his conviction that the agent was capable of saving life in emergencies otherwise hopeless. Now, after lengthened experience of his own, confirmed by the testimony of many practitioners in all parts of the world, and notably in London and Dublin, we feel justified in formally recommending the practice. Amongst those who have testified in its favor are A. Farre, Dr. Braxton Hicks, Dr. Lombe Atthill, master of the Rotunda Hospital, Dr. John Byrne, and Dr. Playfair. These and many other distinguished obstetrists have used it, because they found that women were liable to die of hemorrhage under what are styled the "ordinary means."

Iodine proposed by Dupierris[2] has been much used since. It is a valuable styptic. But from comparative trials we have made of it with iron, we are satisfied that it is less trustworthy in severe cases. In minor cases it may be used after injecting hot water. The formula is, tincture of iodine ℥ij, water ℥viij.

The formula for the iron-styptic is: solid ferric chloride ℥j, dissolved in ten ounces of water; or of the liquor ferri perchloridi fortior (Ph. Br.) ℥jss.; water, ℥viijss. The rules in using it are: (1) be sure that the uterus is empty of placenta, blood, and clots; (2) compress the body of the uterus by the hand during the injection; (3) have two basins at hand, one containing hot water, the other the ferric solution, pump water well through the syringe (a good Higginson's will do) so as to expel air, then pass the uterine tube into the uterus, and inject first hot water so as to wash out the cavity and give a last opportunity for evoking diastaltic contraction; then shift the receiving end of the syringe into the ferric solution, and slowly, gently inject about seven or eight ounces, carefully keeping up steady pressure on the uterus throughout and afterwards.

An objection, not without force, has been raised to injection, namely, that it may excite contraction of the uterus, and this contraction may drive fluid along the tubes. To meet this we devised large vulcanite tubes perforated at the uterine end, which was loosely packed with sponge saturated with the ferric solution. When introduced, a piston run down compresses the sponge, and the fluid exudes into the uterus. The plan has its use, but it is less certain than a gentle stream flowing over the whole surface. We now use a strong glass tube, channelled on Neugebauer's plan, which insures the ready return of fluid from the uterus. Some physicians have advised sponge-swabs. These are bad.

When the hemorrhage is associated with *fibroid tumors*, the equable conservative contraction of the uterus is almost always frustrated. In these cases it is especially desirable to resort to styptic injections at an earlier stage.

Now it is right to consider *the dangers associated with ferric injections*. These Robert Barnes examined in a memoir brought before the Obstetric Section of the International Congress, 1881. In the discussion no facts were adduced in proof of the danger of the practice. The cases in which death has followed the method have been subjected to a rigorous analysis by Dr. Pollard.[3]

[1] Beiträge zur Geburtsh., 1846,
[2] North American Med.-Chir. Rev., 1857.
[3] Brit. Med. Journ., 1880.

Analyzed, the dangers that have been urged may be classed as follows: (1) those accidents which are common to all intrauterine injections, and which have even attended other obstetric manœuvres. After great losses of blood, women have died from *shock or syncope* occasioned by passing the hand into the uterus; by suddenly sitting up, during the grasping of the uterus from without, under the simple injection of cold water. If, during the deep depression following severe hemorrhages, the slightest disturbance may precipitate death, it is not easy to understand how a simple injection of cold water, which in itself is capable of causing death, should be made more dangerous by the addition of iron in styptic proportion.

But air may be forced into the uterus and the sinuses, and thence be carried to the heart. Numerous experiments on animals prove that small quantities of air may enter the veins with impunity. In the human subject the experience is mainly drawn from operations about the face and neck. Here a vein has been opened which is within the area of the powerful suction or vacuum force of the chest. The conditions of the uterus differ considerably. Poisseuille denies that there is any suction force of the abdomen. We are, indeed, satisfied that there is. The downward and upward movement of the uterus, bladder, and anterior wall of the vagina, the intermittent flow of urine by catheter during inspiration and expiration, are experiments in proof; and in a case in which we tapped by aspiration a retrouterine cyst, there was a backward flow during expiration.

Aspiration to Heart.—Valsalva proved that at the moment of inspiration the venous blood of the jugulars flows more rapidly towards the chest. Barry proved (1825) that an aspiration-force was exerted on the veins near the thorax, and gave the measure of this aspiration-force.

Veins would collapse under this aspiration-force unless kept open by attachment to surrounding parts.

The dangerous zone of aspiration extends beyond the region of the neck.

A similar effect is produced on the abdominal side where the vena cava traverses the diaphragm, and at the opening of the subhepatic veins. At these points, the blood, compressed by the positive pressure which always exists in the abdomen, finds in front of it the negative pressure of the thoracic cavity, and is thus drawn towards this cavity. Hence, says Marey, entry of air into veins of the abdominal region would be equally to be feared.

Again, the blood returns to the heart from all the venous channels by a centripetal force, and this applies to the uterine sinuses. Besides—and this fact has other important applications—when a woman lies on her side, the flaccid belly and uterus bagging down, if the hand be introduced, air may be felt to rush in along the arm and hand of the operator. But allowing full weight to these facts, death from entry of air into the circulation during ferric injections has not been proved.

As air may enter the veins, so may *the ferric solution, and cause clotting of blood* in the right heart. Observations of this kind are known as the result of operations upon the face and neck. Only one presumable case of this kind has been observed, that of Dr. Atthill, and this eminent clinician concludes that it is doubtful whether the death was due to the ferric injection. Embolia shortly after parturition is especially to be dreaded after severe hemorrhages. On the other hand, iron has been found in the uterine sinuses; and in the peritoneum carried through the oviducts. In the chapter on the induction of labor will be found other facts bearing upon this subject. Perhaps the most real objection is that some deaths from *septicæmia* have followed ferric injections. The presumed history is this: c
sinuses or in the cavity of the uterus, decompose, br

blood with septic matter. The cases are open to criticism as to the details of treatment: for example, in some, care was not taken to empty the uterus of clots or placenta, thus directly contravening a fundamental rule. And it must be remembered that septicæmia after childbirth, especially when attended by hemorrhage, is a too familiar history, even when no kind of injection has been used.

The decision for or against ferric injections, in otherwise uncontrollable hemorrhages, will rest upon the answers given to the following questions: 1. Is quick death a real danger to be apprehended from hemorrhage after labor? and where the patient escapes from quick death, is she liable to suffer other serious calamities?

2. Are the proved dangers due to ferric injections greater than those proper to hemorrhage?

3. Is the use of ferric injections capable of arresting hemorrhage when other means have failed, and thus of saving life?

Experience supplies the answer. As to the first question, no one who has had a large experience in consulting practice can be ignorant that uterine hemorrhage has issued in death, or some other sad calamity, notwithstanding the diligent use of what are called "the ordinary methods of treatment." The answer to the second is almost a corollary from the first. If death happens from hemorrhage, what worse can happen from ferric injections? It is assumed that the injection is resorted to because the patient is in danger of death, and in many such cases rescue has followed the injection. Is it sound clinical reasoning to contend that because a patient who has been saved from instant death by iron injection, has succumbed to septicæmia it would have been better to let her die of hemorrhage?

As to the third question, the power of ferric injections to arrest hemorrhage and save life, the evidence is too copious and too precise to be any longer a matter of controversy.

Under a deep sense of responsibility, we feel it a duty to urge that in extreme cases of hemorrhage of the third degree, in which the diastaltic function is irresponsive, a last appeal should be made to ferric injection. However much we may fear ferric injection, we fear hemorrhage more, and dare not let a woman die refusing her this last and reasonable chance of safety.

The careful observance of the rules laid down for the use of ferric injections will insure, if not absolute immunity, at least a minimum of danger that cannot weigh against the dangers of hemorrhage.

The immediate dangers of shock, entry of air into the veins or into the peritoneal cavity, of the entry of iron into the veins, are reduced to a minimum by placing the patient on her back, and firmly supporting the uterus during the injection. The remote danger of septicæmia is minimized by taking care not to inject iron until the uterus is completely emptied; by washing out the uterine cavity with carbolic injections daily; and by the use of all those means to obviate septicæmia which will be indicated in the chapter on puerperal fever.

We now consider *the restorative treatment of hemorrhage.* This includes the administration of stimulants and food by the mouth, by the rectum, and by the cellular tissue; Esmarch's bandages; transfusions.

In extreme anæmia, syncope present or threatening, two remedies are instantly indicated. First, place the patient on her back with the head low, and pelvis high, as advised by Nélaton in asphyxia. In aid of this proceeding so as to economize the blood by keeping it concentrated upon the vital organs, we may adopt the old plan described by Smellie: "Others order ligatures for compressing the returning veins at the hams, arms, and

neck, to retain as much blood as possible in the extremities and head." This principle is much better carried out by Esmarch's elastic bands. By the judicious use of these almost all the blood in the limbs may be kept back upon the central organs. Winckel reports favorably of their use in Germany. They may be employed before or at the same time as the immediate means for arresting hemorrhage. It would be very interesting to take observations by sphygmograph, to illustrate the influence of these bandages upon the heart and arterial system.

Then we resort to stimulants by the mouth. But these are not to be trusted in extreme cases. Anything swallowed is easily rejected by vomiting, and if retained it is not absorbed. It is no uncommon thing to see milk, beef-tea, and brandy thrown up half an hour or more after swallowing. The stomach, like the uterus, is paralyzed. Better effects sometimes follow stimulant and nutrient enemata. Dr. Sansom[1] recommends for rectal injection defibrinated bullock's blood or Dr. Craven's desiccated blood in the proportion of one drachm to one ounce of water, or it might even be possible to utilize the patient's own blood, collected and thrown back into the rectum. But for quick good, the true way is to inject a drachm of ether into the cellular tissue. Life has certainly been saved by this means. Absorption seems to go on from the cellular tissue after the mucous membranes have lost the power. Hecker, of Munich, Macan, of Dublin, and others testify to its value. Our own experience is decisive in its favor.

Transfusion.—Of all restorative measures the most direct, the most striking in its effects, is transfusion. It may literally save life, palpitating at the last gasp. It would be more extensively practised if certain difficulties were removed. The great object is to simplify the operation. Two things have to be determined. First, the fluid to be used; secondly, the apparatus and other details of the operation. In its ordinary significance, and perhaps etymologically, transfusion means the carrying of blood from one animal into the veins of another. But the term may, for clinical purposes, include the injection into the veins of other fluids as well as blood.

Blood has been used in two states, namely, pure or *whole blood* as it flows from the veins of the giver, and *defibrinated blood*. Whole blood is best used by the *immediate or vein-to-vein method*. For this Aveling's apparatus is most convenient. It consists of a continuous elastic tube with a small dilatation in the middle capable of holding two fluid-drachms. This dilatation may be likened to the heart of a fish. It may be used to propel the fluid received into it. Instead of valves, which would favor coagulation, the tube is compressed by finger and thumb on the giver's or the receiver's side of the dilated bulb as required. Each end of the tube is mounted with a metal tube for insertion into the veins. The apparatus being ready and emptied of air by driving through and filling with a saline mixture, to be presently described, the veins are bared. The receiver's median cephalic vein is bared by pinching a fold of skin, transfixing this transversely to the vein by a thin knife, dissecting down gently to the vein, so as to expose it for half an inch; a probe may be passed under the vein and pressure kept upon it to save loss when opened. Hine passes a catgut ligature on the vein, and incises above the ligature. The nozzle of the transfusing apparatus is then slipped into the vein directed towards the heart. If Aveling's instrument is used, a little propelling force may be necessary. This should be done very gently. Watch the effect upon the patient. When ten or twelve ounces have been taken in, the operation is usually completed. The canula is then removed, and a small compress is bound over the wound. The vein of the giver is also secured

[1] Lancet, 1881.

in like manner. Roussel's apparatus for immediate transfusion attracted much attention some years ago. Having used it as well as Aveling's, we much prefer the latter. Roussel's is too complicated.

There are two natural forces which have aided the transfusion; the driving force of the giver's heart, which is not unlikely to fail from emotion, and the suction-force of the receiver, also often very feeble. Hence an artificial propelling force is often wanted. This in Aveling's apparatus is supplied by pressure on the bulb.

But a preferable artificial momentum can be had by gravitation, which acts smoothly and admits of most accurate graduation. A gravitation-apparatus is especially adapted to defibrinated blood, milk, or saline solutions. Whole blood may indeed be kept fluid by being protected from contact with air, moving, and cool (Oré), and mixing a little ammonia or phosphate of soda. But with every precaution it is liable to clot, and thus to frustrate the transfusion. Defibrinated blood has several advantages; you may take the blood from the giver in an adjoining room, thus avoiding a great source of emotional disturbance; the defibrination is deliberately performed; the blood thus prepared is free from the danger of clotting; and the whipping brings the blood-globules into contact with air and so takes up oxygen.

Transfused blood does good in two ways: 1st, by mere volume, helping to fill the vacuum left in the circulation; in this way it assists the dynamic action of the heart. 2d, the red globules help to reconstitute the blood, and carry the healthy stimulus to the nervous centres. But it is of great importance that the blood be thrown in slowly and gradually. If done rapidly the heart may be overpowered.

The value of defibrinated blood is disputed. Hayem condemns its use. Although the proportion of globules may be increased, it is still a question whether they retain their virtue. A condition that follows transfusion is hæmoglobinuria. Landois and Ponfick confirm the observations of Hasse on this point. Albuminuria is commonly associated with it. This especially occurs when the blood of a different species is transfused. The globules of lambs' blood are rapidly dissolved in human serum. This is, says Landois, the source of the hæmoglobinuria. Hayem and Schaefer condemn absolutely transfusion of blood of other animals. Schaefer[1] also condemns milk. He contends that the only fluid which can be employed with any benefit in the human subject is human blood, either normal or defibrinated. He insists upon the simplest form of apparatus.

Several gravitation transfusers compete for selection. Little's, McDonnell's, Wagstaffe's (figured in the "Obstetric Operations," 3d ed.), and Hine's (described, "Lancet," 1881) have all been approved by clinical experience.

If indicated, transfusion may be repeated.

If blood cannot be obtained, the saline solution used by Dr. Little in cases of cholera will serve. This solution consists of chloride of sodium, 60 grains; chloride of potassium, 6 grains; phosphate of soda, 3 grains; carbonate of soda, 20 grains; distilled water, 20 ounces, raised to 91° F. Hicks[2] speaks highly of the value of an admixture of a solution of phosphate of soda with blood, whole or defibrinated. The coagulation is thus prevented, and material for transfusion can be obtained when vein to vein transfusion cannot be accomplished.

Secondary Puerperal Hemorrhages.

Primary or paulo-post-partum hemorrhage may have been arrested, and yet, twenty-four hours or later, bleeding may again break out. At this time

[1] Report to Obstetrical Soc., 1879. [2] Obstetrical Transactions, 1879.

the involution process has begun. The uterus ought to be sensibly diminished in bulk, and firm. Only the *lochial discharge* should be going on. This varies in amount in different women. On the second day the discharge is still sanguineous, but serous fluid predominates. Day by day the proportion of red blood lessens, the discharge assuming a more watery character, tinged from red to dirty green—"*the green waters.*" By the end of a week the discharge is commonly muco-serous, still tinged with green. Some muco-serous discharge goes on for two or three weeks more.

The day after labor, in pluriparæ, it is not uncommon for a large clot to be passed. This is preceded by "*after-pains*"—that is, by colic or spasm of the uterus. Commonly, relief is obtained when the clot is passed. The uterus contracts firmly, and there is no more bleeding. But in delicate women of lax fibre, especially in pluriparæ, and after exhausting labors, it is not uncommon for the uterus to become distended by blood, which clots and is retained, the serous part escaping. This is paulo-post-partum hemorrhage. At this time there are restlessness, uterine pains, tenderness on pressure over the hypogastrium. On loosening the binder to feel the uterus accurately, this is made out rising above the symphysis, perhaps half-way or more to the umbilicus. The first thing to do is to pass the catheter. A full bladder would interfere with the necessary manipulation, and is itself a cause of defective uterine action. The next thing is to grasp the uterus firmly, to squeeze out its contents, then apply a pad and binder. Any hemorrhage after this is puerperal or secondary hemorrhage—a symptom to be vigilantly watched, since it is a source of danger by itself, and also by being frequently associated with septicæmia.

The Causes of Secondary Hemorrhage.—If due care have been taken in the conduct of the labor, and especially in the management of the placenta and any primary hemorrhage, we shall rarely experience the mortification of seeing secondary hemorrhage. This will be evident if we trace the principal ascertained causes of secondary hemorrhage: These are:

A. *Local Causes of Secondary Hemorrhage.*

1. A portion of placenta or membranes has remained in utero.
2. Clots of blood may have formed and been retained.
3. Laceration or abrasion of the cervix, vagina, or perineum, or a vesico-vaginal or vesico-urethral fistula.
4. Hæmatocele or thrombus of the cervix, vagina, vulva, or perineum.
5. Chronic hypertrophy, congestion, or ulceration of the cervix uteri.
6. Malignant disease.
7. General relaxation of the uterine tissues.
8. Fibroid tumors and polypi.
9. Inversion.
10. Retroflexion, retroversion, or anteflexion of the uterus.
11. Pelvic peritonitis or cellulitis fixing the uterus.

Constitutional or Remote Conditions causing Disturbance of the Nervous and Vascular Systems.

1. Emotions.
2. Sexual intercourse.
3. Returning ovarian action, recurring commonly at the end of a month, or ovarian action, favored by failure to suckle, and imperfect involution of the uterus.
4. Heart disease, including imperfect involutio

5. Liver disease.
6. Bright's disease.
7. Leucocythæmia.
8. General debility of tissue, malnutrition of nervous system, and irritab heart from anæmia.

A. 1. RETAINED PLACENTA.—It will be seen at once that some of the causes may be averted. This applies especially to A. 1, retention of placen It is, however, the condition most frequently met with. The flooding h usually set in within twenty-four hours of labor. The explanation h mostly been that rigidity of the cervix uteri rendered the removal of t placenta impossible. In some cases the attendant was not aware that a thing had been left behind. We have in several cases removed the wh placenta a week or more after labor. Flooding is not always the m urgent symptom. Septicæmia almost always attends, just as we see in ab tions in which a portion of the ovum is retained. Hence we get the sign septicæmia, of fever, which will be described in its place. The local object signs are: some distention of the abdomen, tenderness on pressure over uterus, which is felt rising towards the umbilicus; by vagina, the uteru felt enlarged, the cervix more or less open, admitting one or two fingers discharge, muco-purulent, sanguineous, generally of peculiarly offen ire odor; and sometimes retention of urine. These signs indicate the neces sity of exploring the cavity of the uterus. The sound will give the measur e of the uterus. But the only satisfactory examination is made by touch. Some times the finger can enter the uterus by pressing the hand firmly against the perineum; and sometimes the vulva and vagina are lax enough to enable the hand to pass into the vagina, and thus one or two fingers passing into the uterus, aided by pressing the fundus down upon it by the hand outside. But generally this indispensable operation is too painful to be carried out without anæsthetic help. The exploring finger must sweep the whole inner surface of the uterus, hooking down and detaching any adhering placenta or clot.

When the uterus is emptied, wash out with carbolized water, 1 in 50.

2. RETAINED CLOTS.—The same treatment must be pursued in the case of retained clots.

3. LACERATION OR ABRASION OF THE CERVIX is more frequent than is commonly supposed. Hemorrhage from this cause is sometimes protracted and copious. The diagnosis is established partly by the method of exclusion. You explore the interior of the uterus and find it empty, perhaps well contracted. Then through a speculum, wiping away any obstructing blood or clot by sponge, you see the lips of the os uteri; swab the raw surface with solution of perchloride of iron, apply dry cotton-wool, and gently plug with lint which has been soaked in carbolized water. The plugs can be removed and the treatment repeated if necessary. If the rent be extensive, the question of stitching up at once by wire or silk sutures may be considered. Emmet says even moderate rents frequently cause cellulitis at the time, and arrest involution. His operation may be done some time afterwards.

LACERATION OF THE VAGINA OR PERINEUM.—These have been discussed in connection with rupture of the uterus. They may be detected by visual and digital examination. Compresses of perchloride of iron may be necessary. A little bleeding may also continue from vesico-vaginal or recto-vaginal fistulæ, but as these injuries partake more of the nature of sloughs than of rents, they rarely cause anxiety on account of the hemorrhage.

4. THROMBUS OR HÆMATOCELE is described in the next section under B.

5. CHRONIC HYPERTROPHY, OR ULCERATION OF THE VAGINAL PORTION, will be detected by touch and speculum. The part may be touched with *nitrate* of silver or tincture of iodine. Astringent lotions will be useful.

6. Malignant disease has been described elsewhere.

7. General relaxation of the uterine tissues is mostly associated with systemic debility and malnutrition. Constitutional treatment is especially serviceable. Iron, strychnine, phosphoric acid, quinine, and ergot are valuable. But the intrauterine application of iodine every three or four days is useful.

8. The complication of Fibroid Tumors and Polypi is discussed in the chapter on Dystocia. If first discovered some days after labor, the treatment is still the same as that recommended when found at the time of labor. In the case of tumors, we must restrain hemorrhage by the topical application of perchloride of iron. Sometimes the tumors can be removed by enucleation. Polypi should be removed by the wire écraseur.

9. Inversion is discussed in the succeeding chapter.

10. Retroflexion of the uterus is a frequent cause of secondary hemorrhage. The displacement occurs soon after labor, the heavy fundus falling backwards, while the tissues are in a relaxed state. In a considerable proportion of cases there had been retroflexion before the pregnancy. In such cases the displacement is especially apt to recur and to persist. The diagnosis is made out by the fingers in the vagina feeling the rounded mass of the fundus uteri behind the os, bulging downwards and forwards the posterior and upper part of the vagina; by the finger in the rectum, which determines the rounded mass of the fundus even more accurately; by the finger in the vagina passing up in front of the os uteri to meet the hand pressed down from above the symphysis, revealing the absence of the uterus between them; and still more absolutely by the uterine sound, the point of which must be turned back to enter the body of the uterus. The finger pressing upon the posterior down-looking wall of the uterus lifts it up, aids the entry of the sound, and partly restores the true position. The treatment consists in completing the reduction of the uterus; it should then be maintained *in sitû* by a Hodge pessary. If bleeding continue, the cavity should be swabbed with iodine or perchloride of iron. The constringing effect of this, by lessening the bulk of the uterus, tends still further to correct the retroflexion.

11. Perimetritis Fixing the Uterus.—When this condition arises, involution is impeded; the uterus becomes engorged from the impediment to its circulation; it cannot fairly contract. There is also some shedding of epithelium from the cervical cavity and os externum. Hence bleedings are frequent. Rest and quinine best promote absorption of effused fibrin. The bared surface may be touched occasionally with iodine or nitrate of silver. Intrauterine injections of hot water, 110° F., are of striking efficacy.

B. *The management of secondary hemorrhage depending upon constitutional or remote causes* must obviously consist in avoiding or lessening the influence of those causes.

1. Emotions.—Some women are so excitable that the mere application of the child to the breast will cause hemorrhage. Here we have an example of the influence of breast irritation acting unfavorably. The normal influence of suckling is to promote uterine contraction and involution. It may thus be regarded as a provision against hemorrhage.

2. Sexual Intercourse.—The fact is commonly concealed; but the cause is in some cases real.

3. We may observe the Influence of Ovarian Irritation in the not infrequent occurrence of hemorrhage exactly a month after labor. This is more especially the case where suckling has not been instituted. The ovaries then more readily assert themselves, and, resuming work, excite the men-

strual flow, which easily exceeds the normal quantity, assuming the proportions of hemorrhage.

In the greater number of cases considered, the evil does not end with the secondary hemorrhage. The causes continue to work—unless carefully dealt with at once—for an indefinite time, and lay the foundation of chronic uterine diseases, as subinvolution, hyperplasia, menorrhagia, dysmenorrhœa, and displacements.

4. THROMBUS OR HÆMATOMA.—This is a form of hemorrhage sometimes occurring before labor, more frequently during labor, and sometimes becoming recognized after labor. In these latter cases the injury leading to the bleeding was caused during the labor.

Thrombus consists in a collection of blood forming in the submucous tissue or connective tissue. It may occur in the cervix, in any part of the vagina, in the labia vulvæ, and in the perimetric connective tissue.

What may be called a *diffused thrombus* occurs in almost every labor. Under the enormous distending pressure upon the cervix caused by the advancing head, the mucous membrane carried down by the head glides on the deeper tissues by a glacier-like movement. The connecting submucous vessels are torn; blood is extravasated in the form of ecchymoses or small thrombi. This, we believe, is nearly universal. At least we have seen evidence of it in every autopsy of recently delivered women that has come under our observation.

This ordinary form of thrombus will throw some light upon the more pronounced and recognized forms.

Thrombus may occur at any period of pregnancy. It is more frequent as the time of gestation approaches. It is most common during labor.

The predisposing condition is found in the great capillary and venous development in the parturient canal during gestation. The veins, we have seen, are frequently varicose, always excessively full of blood, with a tendency to stagnation. This is aggravated by the pressure of the gravid uterus upon the pelvic vessels. This tells more especially upon the vulva. If in this case unusual pressure upon the parts above be applied so as to retard the return of blood, slight causes may lead to the vessels bursting. The rupture of the vessels is commonly the result of the excessive distention to which they are subjected by the pressure upon the soft parts above. Occasionally the tumor is developed rapidly before the head comes down to the outlet, forming a mechanical obstacle to the completion of labor. The distention is at times so rapid and great that the walls burst, and considerable hemorrhage of an arterial character takes place. But more often, although the rupture of the vessels may occur before the passage of the child, the tumor is developed gradually after its birth. The passage of the head carrying before it the inner layer of the labium, increases the lesion of the vessels. These post-partum thrombi are especially dangerous, partly because they are more liable to be overlooked. They may burst after their walls have undergone mortification.

Acute pain generally marks the beginning of the thrombus, due probably to the rupture of the vessels and the stretching of the tissues before the outpouring blood (Caseaux). The effusion may be limited to the loose connective tissue of the vulva, but it may be very extensive. Thus, Caseaux relates a case in which he traced the blood dissecting up the peritoneum, all up the iliac fossa, where it formed a large coagulated mass; it extended, still behind the peritoneum, up the left and posterior part of the abdomen, as high as the right hypochondrium, bathing all the cellular tissues surrounding the kidney, and even to the attachments of the diaphragm.

If the tumor burst, the hemorrhage may be so great and rapid as to

ve quickly fatal. If it fail to burst it may become so large as to close vagina and lead to the retention of lochia (Lachapelle). It may also d to retention of urine and feces.

THE ISSUE AND PROGNOSIS.—When death occurs it is usually from hemhage internal or external. Gangrene or suppuration may prove fatal at ater period. Cases have ended by resolution, suppuration, bursting, periitis, or septicæmia.

Hugenberger thus summarizes[1] the issues of the puerperal hemorrhages erved by him: 1. Perineal hæmatoma before labor, consecutive abscess, foration of rectum, recovery. 2. Labial hæmatoma before labor, supration of the burst blood-gathering, pyæmia, death. 3. Labial hæmatoma fore labor, suppuration of the burst gathering during puerpery; fatal tro-peritonitis and pyæmia. 4. Labial hæmatoma, bursting, recovery. 6, 7. Labial hæmatoma, incision, recovery. 8, 9. Perivaginal hæmatoma er labor, bursting, recovery. 10. Perimetric during labor; violent laborins, fatal hemorrhage. 11. Perimetric after labor, with cross-birth and rning, bursting of the sac, and death by bleeding into the abdominal cavity. The prognosis is serious. Deneux collected sixty-two cases, of which enty-two were fatal. In two of these the child was also lost. But we ink this statement of the mortality would be reduced could we obtain a rger number of cases, including cases of all degrees of severity.

THE COURSE AND SYMPTOMS are well illustrated in the following clinical ustrations. A patient of the Royal Maternity Charity was the subject. rimipara, labor ordinary. Following labor the midwife observed a mass otruding externally, which she took to be the bladder and vagina prosed. She was seen by us two hours after labor. There was a soft tumor, e size of a child's head, projecting from pubes to anus. In front it seemed nse, shining, translucent; fluctuating; its side presented similar characters; e circumference, the base, was continuous with the skin of the labia and ighs. Posteriorly was an inflexion of the tumor, having an anterior lip uch ecchymosed, and the posterior lip forming a sharp crescent, the whole uch resembling the os uteri after labor. Pursuing examination up this rifice we found that the swelling was caused by enormous distention of the bia vulvæ, especially of the left labium, by blood and serum. On the ternal aspect of the left labium, about one inch from the orifice, was a gged hole, which communicated with the sac formed by the effusion in the bium. Through this some sanious matter escaped on pressing the swelling. t was a rent made in the mucous membrane by the head during delivery. he tumor quickly diminished during the next two days, and the woman did ell. It is not common to find the tumor so large as in this case.

The following is equally instructive, and illustrates another point in the bject. *Hypertrophy of the cervix procidentia, hæmatoma.* A midwife of the oyal Maternity Charity sent in great alarm, thinking the entire uterus had ome out after the child and placenta. We found the patient prostrate, cold, gitated; a large mass lay forth beyond the vulva, of dark color, like coagulated blood, resembling in bulk and aspect the placenta. We next thought it might be the inverted uterus. Some hemorrhage came from it. The mass was soft, its covering easily tearing on slight pressure; it was found to consist of two lobes, and between them was an opening admitting two or three fingers some distance. This was the os uteri; the two lobes were the lips of the cervix uteri, enormously enlarged by infiltration with serum and blood. On pressing the mass to reduce it, the mucous membrane easily tore, and blood oozed out. To guard against this the mass was covered with a napkin;

[1] St. Petersburg. medic. Zeitung, 1865.

then by careful and gradual compression it was returned within the vagina. A perineal compress was applied to prevent descent. The patient did well. This was a most aggravated example of the contusions and injury which the cervix is liable to during labor. It was greatly elongated and hypertrophied.

We have some reason to believe that a varicose condition of the cervix, similar to that which so frequently exists in the labia vulvæ, may lead to thrombus of the cervix.

Dr. Gustavus Murray relates a case in which severe hemorrhage occurred in two successive labors before the passage of the head. The source appeared to be the bursting of a mass of varicose veins—a form of hæmatocele—just within the lower zone. On one occasion hemorrhage recurred a fortnight after labor.

Perimetric Thrombus or Hæmatoma.—Effusions of blood are occasionally recognized in the connective tissue of the broad ligaments, in the mass of connective tissue connecting the cervix uteri with the base of the bladder, and in the connective tissue between the lower part of the posterior wall of the uterus and the rectum, where the peritoneum is reflected off. Probably minor degrees of effusion of blood in the broad ligaments are not uncommon; they may rapidly disappear by absorption. Certainly serous effusion in this place is common, if not universal. We believe these blood-effusions are sometimes a factor in the origin of pelvic cellulitis or parametritis.

Blood-effusion in the utero-vesical mass of connective tissue we have detected several times. These effusions are recognized by the same objective signs as pelvic cellulitis. The differentiation is made by observing the time at which they form. Hæmatoma becomes manifest within a few hours of labor; the inflammatory effusions take several days to develop, and are not commonly pronounced before the tenth day.

The diagnosis is not always easy. When the tumor has attained a moderate size it presents a shining aspect of purple or bluish-black color. It tends to occlude the entry of the vagina, whilst the finger, passed above it, defines its extent and relations. The rapid formation with pain, the fluctuating feel of the tumor whilst recent, and its hardness if the blood has coagulated, are characteristic.

The Treatment.—Is there any *prophylaxis?* The treatment will depend upon the stage when the effusion is observed, its degree, and other accidental conditions. If it form before the descent of the child, we may first endeavor to restrain the effusion by ice and pressure. If this is not successful, whether the tumor by its bulk impede labor or not, it will be better to open it by the lancet, and to deliver by forceps. Thus the danger of further injury under the attrition of the head is lessened. If the tumor have burst and hemorrhage be at all profuse, the first effort should be to deliver by forceps if the head present. Thus we shall be in a position to apply means to arrest the bleeding.

When the case comes under care after labor, Fordyce Barker advises to enlarge the opening by incision, to clear out the clots; and to compress the cavity with lint soaked in solution of iron. When the hemorrhage is fairly arrested, care is required to obviate sloughing and septicæmia from decomposition of the clots. The styptic plug should be replaced by dressings with carbolic acid oil, and frequent syringing with a solution of carbolic acid (1 in 50). It is well to remember that hemorrhage may arise from laceration of the vulva apart from thrombus. The great principle of "rest" finds useful application here.

The Consequences of Hemorrhage.

These are often serious, and prophylactic treatment is important. In many cases it is true that women recover in the most surprising manner after formidable losses. But every woman who has lost much should be carefully watched. The quality of the blood remaining in the system, as well as the quantity, is altered. There is more fibrin in proportion to the globules. The circulation is especially open to accumulation of waste-matter from within, and to invasion by noxious matter from without. These conditions are the essential factors of two graver affections—thrombosis and septicæmia. These will be studied by and by.

Hughlings Jackson records ("London Hosp. Reports," vol. i.) a case of hemiplegia of the right side and loss of speech following on severe flooding. Power gives examples of blindness.

One of the most immediate dangers is *syncope*. Under the depressed state of the nervous and vascular system, the low tension, any disturbance physical or psychical may cause such perturbation that the heart is easily overpowered. It ceases to beat. This syncope is sometimes associated as cause or effect with thrombosis and embolia. But sometimes no blood clotting is found in fatal cases; and some recover. To obviate this danger, the recumbent posture with the head low should be rigorously observed. Nourishment should be carefully attended to. Light soups, or easily digested food, should be given in small quantities at short intervals. Moderate doses of stimulants, as brandy or champagne, must be allowed. Ether, compound spirits of ammonia, bark and cinnamon may be usefully combined; sometimes opium. The great principle that rules over all is to enforce the most absolute rest, encouraging sleep and peace of mind, and removing every source of emotion. Two persons should help in washing the patient, changing the linen, or making the bed, so as to avoid exertion on the part of the patient.

CHAPTER XX.

ACCIDENTS OCCURRING DURING AND FOLLOWING UPON LABOR, *continued*—LESIONS OF THE PARTURIENT CANAL—RUPTURE—INVERSION—RETROVERSION—SUBINVOLUTION—RETENTION OF PLACENTA.

ANY part of the parturient canal may suffer injury before and during the act of labor. The immediate cause may be (1) spontaneous or autogenetic—that is, due to some disturbance arising in the course of gestation or labor; or (2) the result of violence inflicted from without.

Rupture of the uterus has this affinity to the Cæsarean section, that it is sometimes produced by conditions similar to those which determine us to perform the Cæsarean section. Indeed, a leading motive for resorting to this operation is to avoid rupture. And where rupture has occurred, it is commonly necessary to open the abdomen in order to remove the fœtus. There are, in fact, cases of dystocia in which Nature, unable to effect delivery *per vias naturales*, seems, by rending open the uterus and extruding the child into the abdominal cavity, to endeavor to accomplish that which the surgeon accomplishes by cutting open the uterus after laying open the abdomen. It rests with the surgeon to meet nature half way, by performing abdominal section, to get at the child cast out into the abdominal cavity.

There are few subjects in obstetric practice more interesting, or possessing a wider range of relations, than rupture of the uterus. A full knowledge of the conditions under which the accident may arise, of the symptoms and terminations, is of the highest importance in medical and in medico-legal relations. The accident rarely happens without some imputation or suspicion of malpractice, by omission or commission, falling upon the medical attendant. Even if he escape censure from others he may not escape the torture of self-reproach. And he may deserve neither.

It is, therefore, of the last importance to be well-informed as to the circumstances which lead to this terrible catastrophe; and, when it has happened, to know what to do, and what not to do, not alone in the interest of the patient, but also, reflecting on the fearful penalties under which we practise, in our own. It is in the very nature of the accident that it commonly happens suddenly, without warning, and that it thus precludes the surgeon from using means to avert it. "We have been[1] more frequently consulted in criminal charges connected with rupture of the uterus than with any other obstetric casualty. In almost every instance the conclusion that the accident arose from unavoidable causes proved to be the best founded."

Frequency.—In 154,303 labors summed up from various sources, 117 ruptures, or 1 in 1318, were observed.

The uterus may undergo (1) rupture or bursting; (2) laceration; (3) grinding or crushing; (4) perforation; (5) avulsion, or tearing away.

Definitions.—It is desirable to attach definite meanings to certain terms. By so doing we shall at once effect a natural classification of cases that will much simplify the inquiry.

1. *Rupture or bursting* occurs when, under strong tension of the uterus

[1] Robert Barnes: Obstetric Operations, 3d ed.

upon its unyielding contents, its walls burst more or less suddenly in the body or cervix.

2. *Laceration or rent* occurs when a breach begins at the edge of the os uteri, and extends.

3. *Grinding or crushing* occurs when the uterus is subjected to long compression between the child's head and the pelvic wall.

4. *Perforation or boring through* occurs when tissues give way from disease, or long compression at one point, or from penetration by a spike of bone or by instruments.

5. *Avulsion.*—The uterus has been torn away by manual force.

Ruptures, again, are *spontaneous*, or *inflicted from without.*

Ruptures may be *complete*—that is, involving all the tissues of the uterus; or *incomplete*, involving only a part of the wall.

The following general propositions may be stated:

1. The non-pregnant uterus may burst.

2. The uterus may burst at any period of gestation independently of labor proper.

3. Any part of the parturient canal may be lacerated during labor. But the most common seat is the cervix.

4. By far the greater number of cases occur during labor at term.

5. The uterus will not burst unless it be in a certain degree of tension from containing something in its cavity.

6. The uterus may burst in childbearing women of all ages; in women pregnant for the first time, or in women who have borne one or more children; but by far the greatest number of cases occur in pluriparæ.

7. The healthy uterus may undergo spontaneous rupture.

It is more in accordance with clinical and pathological history to take the varieties of uterine lesion successively; to study them separately at first; and then to consider their natural relations and common features. For example, the cases of rupture or bursting differ essentially in their etiology from the cases of grinding or perforation.

1. *Bursting or Rupture.*—This lesion most frequently begins in the uterus. The uterus contracting forcibly, either suddenly or persistently, upon its unyielding contents, as when the liquor amnii is present and the cervix does not yield a vent to relieve the tension, under the law of fluid incompressibility the uterus must burst. The only compensating factor is the small amount of oozing of liquor amnii through the uterine wall. This can rarely be sufficient. The uterus may also burst, struggling upon solid contents.

Causes.—These are sometimes complex. The explanation most commonly given of rupture of the uterus is that it is produced by obstruction to labor. The history of the great majority of reported cases proves that obstruction to labor was the immediate antecedent. But this explanation can scarcely apply to those cases where the uterus suddenly bursts during pregnancy, when there is no labor, properly speaking. The immediate cause is comprehensively stated in the following proposition ("Obstetric Operations," 3d ed., p. 323): "The uterus ruptures because there is a loss of balance between the expelling power of the body of the uterus and the resisting power of the parturient canal, the resisting power being in excess."

Violent action of the uterus is sure to evoke *reflex or voluntary action of the abdominal muscles.* Trask, analyzing the 417 cases he had collected, says: "Inordinate voluntary exertion deserves to be enumerated among the causes of rupture. We believe no case of rupture has yet been (1856) published in which chloroform was used, which may be due to the fact that voluntary effort is greatly suspended under its influence." We cite this statement in order to draw attention to the negative evidence borne in favor of ch

form. If rupture has since Trask's time been observed under chloroform it is important that the cases should be recorded. Tyler Smith says: "In ordinary labor, some amount of voluntary or instinctive action of the muscular system, and particularly of the expiratory muscles, is quite natural during the stages of propulsion and expulsion. In acute or severe labor, these voluntary exertions are productive of great mischief, as laceration of the uterus and perineum, or exhaustion."

Obstruction to the extrusion of the contents of the uterus obviously lies at the foundation of nearly all, if not all, cases of lesion of the parturient canal. The empty uterus can hardly be supposed to rupture itself.

If we cannot state with precision the exact causes of rupture, we may arrive at valuable practical knowledge by studying *the conditions under which rupture has been observed to occur.*

1. RUPTURE MAY TAKE PLACE IN THE NON-GRAVID UTERUS.—Duparcque cites cases.[1] But in these cases disease of its tissues, as thinning, softening, degeneration, or abscess, appears to be a necessary condition. Other factors are: closing of the os and accumulation of fluid in the cavity. Perforation by cancer—a distinct event from bursting—is not uncommon.

We do not dwell in this place upon the cases of direct injury to the uterus by wounds. Such may, of course, occur at any time. It is well to remember that blows inflicted upon the pregnant womb, may wound, even kill the child, without causing rupture of the womb. Duparcque gives an example.

2. RUPTURE DURING GESTATION.—It has been stated that sudden violent efforts of the child have caused rupture. The cases cited in support of this proposition are not convincing. It is more probable that the uterus, excited by violent action, ruptured itself, or that some violence external to the uterus was concerned.

Spontaneous rupture is rare, but the accident is well authenticated. Indeed it is not more surprising than spontaneous rupture of the heart. It is known to have occurred as early as the *third month.* Mayer relates (V. Siebold's "Journ. f. Gebtsh.," Bd. III.) a case of rupture in the third month. The uterus had been the subject of Cæsarean section. H. Cooper ("British Med. Journal," 1850) saw a pluripara of 30, who was taken with collapse after dancing, and died next day. The uterus was found torn at the left side of the fundus, a three months' fœtus projecting through the rent. The tissue at the part was thin, pulpy, cheesy. There was tubercular degeneration. Duparcque gives an example in which the cause assigned was vomiting. It has occurred in the *fourth month.* Dr. McKinlay relates a case ("Glasgow Med. Journal," 1861). Without any exertion or injury a woman died after being taken ill the previous night. The uterus was ruptured across the fundus. Its tissue was apparently healthy.

It has also happened from violent exertion and fatigue or injury, as a blow or a fall, or from severe vomiting. The influence of over-exertion is illustrated in a case by Duparcque. A woman was carrying a weight on her head, when symptoms of internal injury set in; she rallied for a time, had another attack, and died. The uterine cavity contained a fœtus of three or four months. There was a fissure in the fundus near the right tube. This was probably a case of gestation in one horn of the uterus.

Dr. Harrison ("Amer. Journ. of Med. Sc." vol. viii.) relates the case of a pluripara, who in the *fifth month,* after a long walk, felt a sudden and severe pain "as if something had given way within her." She died in a few hours. Blood and the fœtus in its membranes were found in the peritoneal cavity. There was a transverse rent from one Fallopian tube to the other. There

[1] Maladies de la Matrice, 1839.

was no thinning or appearance of disease. Such a case as this and succeeding cases support the theory of bursting set forth at page 609. Collins relates a fatal case at five months. Hohl cites from Mangold a case of rupture at the fifth month.

The late Mr. Scott, of Bromley, relates ("Medical Repository," vol. viii.) the case of a woman in the *sixth month*, who was awakened from sleep by a sudden pain about the umbilicus. Rupture of the uterus was found at the fundus, through which the fœtus enveloped in its membranes had escaped into the abdominal cavity.

Mr. Mitchell relates ("Obstetrical Transactions," 1870) the case of a woman in the *seventh month*, who died after sudden abdominal pain caused by terror from lightning. The uterus had burst apparently under contraction upon the projecting knee of the fœtus. Other cases will be found in Trask's Memoirs ("Amer. Journal of Med. Science," 1848 and 1856).

Some of the ruptures in early gestation were not examples of ordinary uterine gestation, but were undoubtedly ectopic. Thus, Canestrini relates a case in which there was a double uterus. One of the uteri, after some pains in the fourth month, burst. The ovum was found entire in the abdomen. Goupil cites a case from Payan, of a woman who died under symptoms of shock, causing suspicion of abortion having been procured. Above the proper cavity of the uterus was another cavity found in the wall. This interstitial cavity had become thinned by the growth of the ovum, and burst. This case was probably an example of gestation in the undeveloped horn of a double uterus. The reader is referred back to the history of "ectopic gestation" for further information upon this point.

Spontaneous rupture in early pregnancy is so rare that suspicion of foul play is easily excited. The vagina and uterus have been frequently wounded by instruments used to procure abortion. The character of the wounds may differ from those due to spontaneous rupture. They will show evidence of cutting, stabbing, or bruising, according to the nature of the instrument used. A careful microscopical examination of the tissues, especially at the seat of the lesion, should be made. If found perfectly sound, the presumption that injury has been inflicted from without will be strengthened. This applies almost exclusively to rupture during early gestation. In ruptures at term, disease of tissue is rare, notwithstanding current opinions to the contrary.

In the *eighth and ninth months*, spontaneous rupture is less rare. The *influence of emotion* is again in evidence. Francis White ("Dublin Journ. of Med. Sci.") gives the history of a woman near the end of gestation. She fainted under terror, was delivered a week after, and died almost immediately. A large quantity of blood was found in the abdomen. The rents were seen in the anterior part of the womb, involving the peritoneal coat and some muscular fibres.

Rupture or Bursting at Term, or on the Advent of Labor.—In this order of cases the reversal of the normal relation between active uterine force and passive resistance is more obvious than in early pregnancy. In a large number of cases there is decided mechanical resistance to the expulsion of the fœtus, or to the bursting of the ovum and discharge of the liquor amnii. It is remarkable that rupture of the uterus has frequently happened long before obstruction to labor could be encountered. These cases are similar in the mode of production to those which occur early in gestation, and to bursting of the gestation-sac in ectopic gestation. There is one striking point of resemblance, namely, the frequency with which the entire ovum is cast out into the peritoneal cavity. In this respect they differ from many cases of laceration which occur during obstructed labor, in which the child, or, at any rate, the placenta, is more commonly retained in the uterus. The ex-

planation of these cases appears to be that the uterus is excited to contract suddenly. The ovum being entire, the resistance is hydrostatic. The contents of the uterus are then incompressible. The conditions are analogous to those of the famous Florentine experiment. There is no provision for the diminution of the bulk of the contents of the uterus by the opening of the os uteri. Under these circumstances a moderate contracting force may result in bursting. There can be no doubt that in many cases this catastrophe is averted by the facility with which the membranes burst. Thus abortion may be looked upon as an alternative of rupture. On the other hand, the uterus will often stretch, and in this way also bursting is averted. It is the lower segment, and cervix especially, that stretches. But stretching is a process that requires time. A *sudden* contraction, such as is induced by emotion, gives no opportunity for this, and so the tissue gives way. Belonging to this order are cases of over-distention of the uterus, from twins or triplets. Under these conditions, although the uterus grows in some measure to keep pace with the increasing bulk of its contents, the rate of accommodation is liable to be outstripped by the distending force. The uterus becomes *thinned out*, stretched—therefore weakened. If the thinning happen to be more marked at one part, rupture at that part is very likely to happen if a sudden contraction occur. And especially is this likely if the tissues have undergone morbid change.

This is the more likely to happen, because distention of the uterine fibre is very apt to cause vomiting; and vomiting has been noted as a factor in the production of rupture. The retroverted gravid womb has been driven through the vagina, tearing its way through. This proves the force that can be exerted by the abdominal muscles (see "Retroversion" in "Obstetric Operations"). An ovarian tumor may, in like manner, be driven through the vaginal wall.

The Influence of Disease of Tissue as a Factor.—Reasoning from the observation of some cases in which the uterine tissue was altered by disease, and partly from the analogy of rupture of the heart, the opinion has found favor that alteration of tissue from disease is a necessary condition to rupture. It is affirmed that a healthy uterus will not rupture. The supposed analogy is fallacious. The uterus bursts, as has been shown, under strong contraction upon incompressible contents that cannot escape. This cannot be the case with the heart. Or, in other cases, the uterus tears itself by pulling upon a fixed point, as where the head jams the lower segment of the uterus in the pelvic ring, or as when the uterine fibres pull upon a projecting limb. There is nothing like this in rupture of the heart. Still it is true that there are cases in which the uterine tissue gives way from disease, like the heart.

The hypothesis that alteration of tissue was a necessary antecedent to rupture, was clearly insisted upon by Murphy. He described a *softening* of the tissue as the result of inflammation during pregnancy, as an indication of which there is frequently pain in a particular spot.

Fatty degeneration is the change most frequently described. Klob distinctly[1] says that he has in several cases of spontaneous rupture observed fatty degeneration of the muscular wall at the place of rent. In confirmation, reference is made to the normal process of involution of the uterus, in which, at the end of pregnancy, some molecular change occurs in the muscular cells. If it be held that the ordinary kind and degree of granular change is sufficient to impair the strength of the tissue to the extent of causing it to rupture, it must be enough to point out the extreme improbability of Nature's so bungling as to weaken the uterine tissues at the moment

[1] Pathol. Anat. der meiblichen Sexualorgane.

when the greatest vigor and resisting power are needed. If it be urged that this physiological condition may pass into pathological excess, an argument is used which is more difficult to refute; the more so because, in some cases, direct observation seems to prove that excessive fatty degeneration did exist. But to prove that a particular factor existed in a limited number of cases is very different from establishing it as a general or universal law. And there is abundant evidence to prove that in a considerable number of cases no such excess did exist. 1. Many ruptures have occurred during gestation at periods when even the physiological change is rare—in some of these, the healthy condition of the tissues was established by competent observers. 2. A certain proportion of cases occurring in labor at term were in primiparæ, in whom the presumption is strong against morbid change of tissue. 3. In many cases of rupture at term in pluriparæ the tissue has been found healthy. In four cases examined by Robert Barnes this was the case. In one of these this fact was verified by Dr. Bristowe and Dr. Montgomery. Cohnheim and Bandl found the tissues sound. 4. In not a few cases, recovery, with perfect healing of the wound, has occurred. Duncan's experiments on the power of the uterus to resist bursting, were made on bits of uterus taken from the body of the organ. Because it was difficult to apply force enough to rupture these pieces, he drew the conclusion that the sound healthy uterus could not burst. The fallacies vitiating this conclusion are obvious. The uterus rarely ruptures at its body, but almost always at the cervix and lower segment; and pressure applied to a detached bit of dead tissue is altogether different from what obtains in the living uterus.

Bandl[1] distinctly affirms that the healthy uterus ruptures itself; and says that, because women die of exhaustion without rupture, it is no proof that a sound uterus cannot burst. On the other hand, the frequency of rupture in pluriparæ, in women about forty years of age, who have led a hard life, whose system has been generally enfeebled, makes it reasonable to infer that the uterus partakes of the general weakness or degradation of tissue. In two of the cases seen by Robert Barnes, the muscular fibres of the heart exhibited marked granular change. He describes a similar condition in the heart of a woman who died of accidental hemorrhage; she was also a pluripara, aged about forty, much worn by poverty and hard work. In fact, accidental hemorrhage and rupture of the uterus are apt to occur in the same class of persons. Moreover, in some cases of accidental hemorrhage, the uterine fibre has actually been observed to be torn. In one case of rupture seen by us, there was albuminuria at the end of pregnancy; the kidneys were found in an advanced stage of Bright's disease.

E. L. Ormerod relates ("Bartholomew's Hospital Reports," 1868) the case of a woman in her fourteenth pregnancy; the rent extended from cervix to fundus. He found *follicular disease* about the cervix, and *fibrous degeneration* of the adjacent muscular tissue.

C. Braun describes a *peculiar hyperplasia* of the uterus, in which the body and cervix lose their due relation to each other.

Cancerous degeneration, especially of the cervix and lower segment, has often led to rupture. Dubreuhl relates ("Lyon Médical," 1871) a case where the uterus burst along its whole anterior wall from encephaloid degeneration. In the museums of St. George's and Guy's Hospitals may be seen specimens of fatal rupture from a similar condition. No doubt such specimens may also be found in other museums. But a cancerous cervix may dilate without rupture.

Rigidity of the cervix from cicatricial tissue may also lead to rupture.

[1] Ueber Ruptur der Gebärmutter und ihre Mechanik., Ludwig Bandl, 1875.

A fibroid tumor in the wall of the uterus has caused rupture. There is a specimen illustrating this in the Middlesex Hospital museum. In a case Robert Barnes examined, with reference to a charge of malpractice, a tumor in the anterior wall of the uterus had got jammed between the head and pelvis, causing perforation of the uterus and bladder. A fibroid tumor may also cause rupture by giving an undue fixed point upon which the normal contracting tissue pulls. But rupture is by no means common in this complication.

A stone in the bladder has caused rupture of the uterus. Guillemeau relates a case; vesico-vaginal fistula resulted. In a case seen by ourselves the issue was fatal.

The cicatrix resulting from Cæsarean section has in several instances given way under the strain of labor. Winckel relates two cases.

Extreme thinness has been observed. It may be general or limited to a part. If, as is likely, this thinning be in the lower segment, rupture at this part is very likely to occur. The lower segment, from its peculiar structure, its function of lodging the head, and its having to bear the chief impact of the driving or distending force, is more disposed to thinning and to yield. But apparent thinness may also occur at the fundus, more especially at the presumed origin of a Fallopian tube. In some of these cases there can hardly be a doubt that there was gestation in one horn of an imperfectly developed uterus. Examples of this are given in Robert Barnes's "Diseases of Women." But thinning may be the result of disease, as in a case related by E. Whittle ("Liverpool Med. and Surg. Reports"). The child had passed through a rent near the junction of the body and neck anteriorly. For two or three inches on either side of the rent the uterus was thin and soft. The woman was affected by secondary syphilis, and Whittle believed the degeneration and atrophy were due to this condition. Collins relates a marked case of the kind. Murphy thought "thinning or partial atrophy not an unfrequent cause." It is highly probable that this thinning was not atrophic or pathological, but simply the thinning from stretching under the forces of labor, as Bandl and others explain it.

Bandl's theory is that the essential condition is *thinning of the cervix*. This takes place during labor. Rupture is comparatively rare in primiparæ in whom the muscular walls of the fundus and body are less developed, whereas rupture is frequent in pluriparæ in whom the muscular walls are thicker and stronger. A strong organ, he says, more easily tears its neck than does a weak one. The uterus can, when sound and strong enough, and works long enough, spontaneously tear its normal cervix, when this has been thinned to a certain degree during labor.

C. v. Braun, Grenser, and others, show that the cervix may be thinned to two lines only whilst the walls of the fundus and body are increased in thickness and strength. Bandl, in his thirteen cases, always found the rupture in the cervix. Thus Bandl's observations confirm the theory that we have enunciated—that rupture ensues from preponderating force exerted upon structures that will not dilate (see Bandl's Fig. 158).

Ergot.—In a very large proportion of cases, rupture has occurred after giving ergot. The violent tetanic unintermitting contractions set up must throw enormous strain upon the cervix or the uterus fixed in the pelvic brim. Unless the obstruction be removed by dilatation, it is only too likely that rupture will take place. We have long contended that ergot ought not to be given during labor, since we cannot always be sure that obstruction may not arise.

In the most frequent order of cases, there is no fixing of the lower segment of the uterus, *but the cervix rends, beginning at the edge of the os.*

almost every labor this takes place to some extent, and the trace is found in the cicatrices and fissures of the os commonly seen in women who have borne children. If the os be at all rigid, the head large, if the liquor amnii have escaped early, if the os have been carried down very low, and if the pains be severe—especially if stimulated by ergot—an initiatory rent of this ordinary kind may easily extend upwards into the uterus and downwards into the vagina. In these cases the rent is longitudinal and usually to one side. Dubois observes that the habitual direction of the uterine neck to the left, and the left occipital position of the child, account for the greater frequency of lacerations in the left side.

Fig. 158.

Showing Thinning of the Lower Segment of the Uterus. (Bandl.)

Bandl figures a specimen in which the cervix is nearly 5″ long. Thus is seen how deep spontaneous rents of the cervical portion reach. One rent went the whole length of the cervical mucous membrane, the whole thickness of the vaginal portion, and extended above the insertion-spot of the vagina in the tissue of the uterus. When such rents remain gaping, the cervix afterwards is wanting in the supporting ring; the plurigravida has then no closing os externum, and at the end of gestation and beginning of labor there is only a very short cervical wall.

Alteration of tissue produced during labor is a factor which cannot be doubted. Where the lower segment of the uterus is long compressed between the pelvis and the child's head, the circulation gets stopped; intense congestion of the parts above and below the compressed ring ensues. The part compressed becomes softened, friable, and may yield. If delivery be effected before actual rent, we see the effect of pressure at a later period in sloughing, forming vesico-vaginal fistula, and perhaps even gangrene.

The points at which this bruising or rubbing-through (*Usur, Durchreibung*) of the uterus is liable to occur are chiefly those opposite the promontory of the sacrum (see Fig. 159) and the symphysis pubis. The pectineal ridge be sharp enough to cut through the uterine wall; sometimes the pubic

portion of this ridge, folded back as in osteomalacia, gives points of resistance against which the head may be jammed. Unnatural sharpness of the edge of the pelvic brim or spinous projections—the acanthopelys of Kilian—are even more dangerous than simple narrowing. Unhappily the two conditions are sometimes combined, as in a specimen in St. Thomas's Hospital from a case seen by Robert Barnes. Duparcque cites a case in which "the inferior part of the neck of the womb separated from one side to the other, and the child passed through into the abdomen. The pelvis was a

FIG. 159.

TRANSVERSE OR SEMICIRCULAR GRINDING-THROUGH OF THE UTERUS.

little narrow; the point of the sacrum passed through the posterior part of the womb. The inner and prominent edge of the pubes and iliac resembled an ivory paper-knife."

In *deformed pelves* there is often found at the joints an *excrescence of bone projecting inwards*, so that, when the fœtus presses against the pelvic ring, laceration easily occurs. We have verified this condition. Hence, in all examinations of contracted pelves, the finger should be carefully swept all round the brim when taking note of the kind and degree of the deformity. This bony excrescence is common at the pubic symphysis, and is especially dangerous; it is also found at the sacro-iliac joints. The direction of the lesion in these cases is usually transverse, corresponding to the direction of the pelvic brim.

Dr. Hofmeier relates[1] a singular case of a bony, beak-like projection from a synostosis of the last lumbar and upper sacral vertebræ. This had penetrated Douglas's pouch, as verified by autopsy.

[1] Zeitschr. f. Geburtsh. u. Gynäkol., 1894.

ION OR RUPTURE FROM OBSTRUCTION TO LABOR.—Obstruction
he most familiar immediate cause of lesion of the uterus. Fre-
truction is complicated with one or other of the conditions de-
ve. It is not necessary to do more than refer to the ordinary
structed labor. These will be found described under the head of
It is enough in this connection to mention narrowing and dis-
ne pelvis, tumors blocking the pelvis, rigidity or other diseased
f the cervix or vagina, obliquity of the uterus, excessive size of
ydrocephalus, monsters, a dead child, locking of twins, and mal-
oducing a wedge, the base of which is too large to enter the
raverse the pelvic canal.

anism or process of rupture or laceration from obstruction may be
follows:

e uterus gives way under obstruction, the liquor amnii has almost
discharged. The uterus has contracted upon the child. There
the equably diffused hydrostatic pressure. The necessary con-
is that some part of the uterus be fixed, whilst the rest of the
lling from that fixed point. It is this point which generally gives
arcque says, "Uterine contractions alone are the most frequent
ansverse ruptures of the neck." A muscle in active contraction
tear its own contracting fibres. It tears at its attachments, or at
is pulling upon, just as the tendo Achillis gives way rather than
which pull upon it. If a muscle is not strong enough to accom-
ject for which it contracts, it becomes fatigued and relaxes. This
appens with the uterus, and thus it is saved from rupture. It
n a sudden increased strain or injury is inflicted at the moment
on that the muscular fibres are liable to be torn. The uterus is
n to this law. We see how it acts in ordinary labor. It con-
e direction of its long axis, tending to shorten itself, pulling the
the fundus. So acting, the uterus is partly pulled open, partly
the pressure of the bag of membranes or of the protruding part
s. The effect of the hydrostatic pressure in dilating the cervix
abor is marked. If it fail through too early discharge of the
i, and there be obstruction, so that the fœtus is slow in engaging
ix and in descending into the pelvis, dilatation is slow, and is
effected by the continuous pulling up of the cervix by the action
itudinal uterine muscles. In either case, so long as the cervix—
led upon or stretched—yields, there is no fear of laceration. But
x will not dilate, and the uterus continue to contract, the fœtus
n down violently upon the cervix, the uterus will most likely
e. In such a case the laceration usually begins at the edge of
and extends upwards longitudinally. Or if the fœtus be dead,
ntation be abdominal, so that it cannot traverse the os, a limb—
r elbow—forming an angular projection at some part of the body
us, may render this particular part the fixed point upon which
muscles pull; and this point, gradually softening and weakening,
In this case the rent may be longitudinal or transverse, and at
the uterine wall. But the direction of the rent is usually deter-
he drag of the muscular fibres. Hence, if the rent occur in the
uterus, the rent is longitudinal; if at the lower segment, it is
nsverse.

ays that, in thirty-four cases, twenty-three were labors with boys;
ever's cases give fifteen boys out of twenty cases.

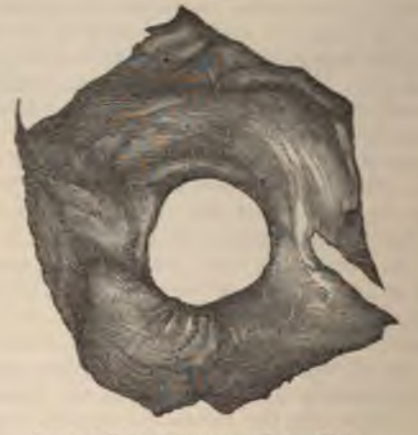
r explanation holds in the g ber of cases of rupture
action of the pelvis. The p re is not in propor-

tion to the degree of pelvic contraction. If the contraction at the brim be so great that the fœtus and inferior segment of the uterus cannot enter, the risk of laceration is less than when there is just that degree of contraction which permits of the descent of the head into the pelvic cavity, but impedes its further progress. This point was well made out by Radford ("Obstetrical Transactions," 1867) and others. In nine cases out of eighteen reported by Radford there was slight contraction only of the brim. Bandl gives evidence to the same effect. In these cases, when the head is forced down, the uterine neck and vagina become fixed between the head and pelvic walls. The uterine muscles continuing to contract, and not being able to propel the fœtus, pulling upon the tissues forming the fixed ring, this will either tear directly, or, being first contused and softened, yields. Hence it is that in these cases the rent is usually transverse or circular, and at the lower segment (see Fig. 159).

Bandl points out how such a degree of pelvic contraction as to cause pendulous belly predisposes to rupture. The strong tension put upon the posterior wall of the cervix thins out this part especially, so that it the more readily tears.

Huber (quoted by Fromont and Hegar) relates a case of a pluripara who died ten hours after labor and vain attempts to detach the placenta by hand. Those had caused intense pain and convulsions. Effusion of blood was found in the abdomen. In the fundus uteri was a spot the size of a five-franc

FIG. 160.



ANNULAR SEPARATION OF THE CERVIX UTERI.

piece, much thickened. From the centre of this spot a band of cellular tissue and varicose vessels stretched to the peritoneum, which was adherent to the musculus transversalis. At the thickened part of the uterus were several rents a quarter of an inch long, from which the blood had escaped. To the inner surface of this spot the placenta adhered so fast that it could be detached only by the help of a knife.

ANNULAR LACERATION OF THE CERVIX.—In some instances, even where there may have been no pelvic contraction, but the os has been rigid, the cervix has been torn through all round, or has gradually sloughed off and been cast as a ring (see Fig. 160).

Cases are recorded by Steidele, Scott, of Norwich, E. Kennedy, Dr. Power, Churchill, Ed. Rigby ("Midwifery," 1844), Dr. Herbert Barker ("Obstetr.

ans.," vol. ii.). Gervis relates a case ("St. Thomas's Hosp. Rep.," 1872) which ring-form detachment was not quite complete. It was replaced thout sutures, as the subject was very prostrate. She recovered, and the ıg reunited. Another case was referred to Robert Barnes by Dr. Hague. these cases the peritoneum is not necessarily involved, and the danger is t great.

But where the lower segment of the uterus is nipped in the ring of the lvic brim, the rent commonly involves all the tissues, at least in some part the circumference. We thus have a direct opening into the peritoneum, rough which the child may pass out of the uterus.

Braxton Hicks relates a case of rupture from *adhesion of the uterus*. No mptoms except pain occurred up to the 8th month, when a slight slip led a sudden yielding of the adhesion-bands and to a laceration of the uterus, e rupture ultimately extending through the uterine wall, the child escaping to the peritoneal cavity.

Circular Laceration or Separation of Uterus from Vagina.—In e class of cases the head enters the pelvis and becomes impacted; a zone vagina is nipped. The uterus continuing to act, a circular laceration is oduced in the manner described. Duparcque shows how it occurs. Once gun, these ruptures may, by the continuing or renewal of the uterine contractions, separate the uterus from the vagina almost completely. Velpeau et with this state twice ("Tocologie," 2ème ed. t. ii.). But the forceps or ınd had been used. The following quotation is very appropriate to the xt: "It will be easily understood how the lifting up of the uterus by ill-rected efforts—as when the woman throws up her belly by suddenly throwg the trunk back, by vomiting or convulsions—may determine a vaginal pture which was only imminent. Abdominal compression so directed as to t up the womb when the dilatation of the orifice is complete may, in the me manner, provoke rupture of the vagina. The same thing may happen om pushing back the child, as this act adds to the state of tension the nal is already suffering; and this is not one of the least common causes of pture of this kind."

In transverse vaginal ruptures the head rarely escapes into the abdominal vity; but the body may easily do so, since the uterus, after rupture, is awn up away from the child. When the whole child goes into the abdoen, it may be because the head has been pushed back by manipulation.

Several cases of *complete circular laceration and separation of uterus from gina* are recorded. We ourselves have known two. Ingleby, Collins, oulin, and Elkington relate cases. It has been objected to the hypothesis spontaneous complete laceration that the uterus could not rend its own gaments. But Casper shows that, during inversion, the round and broad gaments have been torn. In women who have borne many children, all of hose tissues are degraded, the ligaments at the time of labor are not capable much resistance. When the vagina has given way, the whole strain will ll upon them. A little accidental force—as introducing the hand to remove ıe placenta, the application of the forceps, vomiting—might easily complete ıe detachment. The late Thomas Paget, of Leicester, published ("Brit. led. Journ.," 1861) a striking case. A pluripara had a not severe labor of hree hours. The placenta was extracted, with but little traction, in twenty inutes. To this, however, was attached a large fibrous mass, which was ound to be the uterus with Fallopian tubes and ovaries. The vaginal porion hung loose, and was jagged by laceration. She died in forty-five inutes. It was the decided opinion of Mr. Paget that the accident occurred pontaneously.

The following passage from Braxton Hicks ("The Tension of the Abdo-

men"—"Trans. of Med. Soc. of London, 1884") is of special interest in this connection: "The pressure of the intestines is not merely to assist in expelling the uterine contents. It has a conservative effect in preventing what may be called the recoil of the uterus. When the head has passed through the os uteri, but has become arrested by some obstacle in front, and the force of the uterine contractions is expended on the upper vagina and lower uterus, and probably the round ligament, the support given by the action of the abdominal walls through the intestines counteracts the excessive strain, thereby lessening the chances of laceration of vagina. When this support is not given, or is weakened, separation of the uterus from the vagina may be expected if the uterus possesses much vigor, and may be especially anticipated in women whose abdominal parietes are very lax and vaginal tissues weakened."

Although complete separation may occur spontaneously, a transverse laceration of the vagina near the uterus having once begun, very moderate force may cause it to extend. Denman calls attention to this: "I was called," he says, "to a case in which that part where the uterus and vagina are united was ruptured; the child remaining in the cavity of the uterus, the os uteri little dilated." He advised not to deliver, because so much force would be required for dilating that it was feared the uterus would be completely torn from the vagina before the hand could be passed into the uterus, at least before the child could be extracted, "and then the case would have been more horrible." The woman would, in all probability, have had a better chance had she been in the hands of a bolder man, who would have done what Denman dared not to do. But he would have done it at the risk of his own reputation, and of a conviction for manslaughter, with imprisonment as a felon!

Dr. Jamieson relates ("Edinb. Med. Journ.," 1872) the case of a woman whose spine was short, so that the last ribs squatted below the iliac crests. There was great anteversion of the uterus, which therefore acted at great disadvantage. Continuing to contract violently, it tore itself away from the vaginal attachments.

It may seem surprising that the uterus should thus retain power to tear itself apart from its attachments. It might be expected to be paralyzed from the cutting off of its connections with the nervous centres. What these cases prove is that the uterus has in itself an inherent contractile force, which enables it to act for a time independently of the nervous centres. In this respect it resembles the heart, which will beat for some time after removal from the body.

There are specimens illustrative of circular separation in St. Bartholomew's Museum. "Nos. 32–46.—Uterus and vagina. During parturition the vagina was torn through half its circumference, close to the part connected with the uterus. Nos. 32–47.—Uterus, the neck of which was torn through two-thirds of its circumference during parturition. The child was hydrocephalic."

The argument that the uterus ruptures itself is enforced by Roberton, who draws the conclusion that, in the majority of these instances of rupture caused by faultiness in the pelvic brim, the accident occurs within twelve hours after labor has commenced. This implies unimpaired vigor of the contractile force.

Complete separation of the uterus is not necessarily fatal. Ingleby relates a case which occurred to Mr. Cook, of Coventry. "The separation took place the second day after delivery; and the specimen, which embraces the uterus in a state of *inversion*, together with its ligaments, has been deposited in the Birmingham Museum." Weisberg relates a case in which the uterus

was removed for inversion immediately after labor. The woman recovered. In connection with this possibility of recovery, we may now refer to the numerous cases of recovery after removal of the gravid uterus by Porro's operation.

AVULSION. THE UTERUS MAY BE TORN AWAY AFTER DELIVERY OF THE CHILD.—One lip of the os uteri—generally the anterior one—may hang down in a flap, large and loose, even protruding through the vulva. This has been mistaken for the placenta or clot, supposed to be adherent. We have recently seen a case of this protrusion, in which pulling upon the protruding part was narrowly avoided. Duparcque relates a case in which this error occurred, the part pulled upon being actually torn away.

Dr. Walters ("Obstetr. Trans.," 1883) exhibited a uterus that had been torn away by a midwife in the attempt to remove a retained placenta. The uterus was well contracted and empty, the placenta having been expelled during the manipulations. A piece of omentum about twelve inches long had been prolapsed, and was also removed. The woman made an excellent recovery. One ovary had come with the uterus; the other remained. In an extended memoir on the subject (see "Obstetrical Transactions"), Mr. Walters has endeavored to collect all the known cases of avulsion. He refers to fifteen cases of recovery.

Spiegelberg relates a case in which a practitioner, trying to bring on labor on account of convulsions, passed his fingers up the urethra, lacerated the base of the bladder and the urethra. The woman died undelivered in a few hours.

ENTIRE SEPARATION BY SPHACELUS COMPLETED AFTER LABOR.—Cases of this nature must be distinguished from those by laceration above described. Dr. More Madden relates[1] an instructive case. A primipara, aged 33, was admitted into the Dublin Lying-in Hospital, having been eight hours in labor; the os was about the size of a shilling, and the head low down in the pelvis, pressing on the cervix uteri. The pains in the second stage were weak. A stimulating enema and ergot having been tried, she was delivered under chloroform by forceps. No force was required; a child weighing six pounds was born alive in two minutes. She became suddenly collapsed, and died. Autopsy revealed advanced peritonitis. The uterus was intensely inflamed in the cervical portion, which was actually in a state of sphacelus. The ulceration had extended completely through the cervix, so as to have entirely separated the uterus from the vagina. The line of separation was as sharp and clear as if effected by the knife. The vagina was, particularly near the vulva, in a state of intense inflammation, and had sloughed considerably on its anterior wall.

In many cases where rupture has been observed in the body of the uterus, it probably *extended* from the cervix. Collins, Clarke, and Bandl never saw rupture at the fundus; and there is reason to doubt whether some cases reported as such were not really examples of the giving way of the sac of a mural gestation, or of the horn of a one-sided uterus.

Tyler Smith insisted that lacerations may be caused by the irritation of manual examination. Several cases lend confirmation to this view. In one case recorded by Robert Barnes ("St. Thomas's Hospital Reports," 1870), "when examined, the uterus was felt contracting; the os uteri was not reached, but the head was just felt through the anterior segment. Whilst under examination the pains stopped; the woman said she felt something give way. She walked across the room after this, but collapse followed in five minutes." We may, then, admit that rupture may be caused through the excito-motory

[1] Brit. Med. Journ., 1874.

system. But the *centric* stimulus to inordinate uterine action is frequent. In a very large number of cases *ergot* had been given. It is to be remembered that, as in other orders of cases, so it is in this, the *action of the uterus is excessive and suddenly evoked*, and probably disorderly in character, in this respect resembling those which occur before labor, in the circumstance that there is no adequate safety-valve process of cervical dilatation to meet the sudden contraction of the body of the uterus upon its incompressible contents.

Rupture has on many occasions taken place or been extended *during straining at stool.* We have witnessed an example.

Lacerations of the vaginal portion do not always extend through the peritoneum. At the lower segment, posteriorly, the connection of the peritoneum is looser. *Rent beginning at the mucous surface, and involving the fibro-muscular tissue*, may terminate by stretching the connective tissue, so that the peritoneum is dissected off from the utero-vaginal surface. Another condition favoring this escape of the peritoneum is the great distensibility of this membrane. Blood is effused, as we have seen in the description of "thrombus," in this tissue, forming perimetric hæmatocele. The peritoneum is, in fact, undermined by the effused blood. It cannot be rare, since Collins observes that, in nine out of his thirty-four cases, the peritoneal covering did not give way. "Yet," he adds, "death ensued equally speedily, showing that the free admission of air into the abdominal cavity is not attended by any increase of danger."

The part where the blood is effused forms a bulging on the outer surface of the uterus, and the peritoneum may crack. This variety is sometimes called "*partial rupture.*" When moderate in extent, the injury and shock are commonly much less severe than in complete ruptures. External hemorrhage usually attends. The collapse and ominous change of countenance, the sensation as if something had snapped, characteristic of complete rupture, may be wanting. Hecker has drawn attention[1] to a sign depending on the extra-peritoneal thrombus. The pulse, he says, always falls; even at the beginning of the rupture it is quick and small. Then a hæmatocele forms in the connective tissue between the neck of the uterus and the bladder. The swelling thus formed is *smooth, elastic, and quickly growing.* These rents differ from rents in the body of the uterus in that they do not readily close; they remain gaping.

Another form of incomplete rupture is that in which *the peritoneal coat is alone or chiefly torn.* Over the body of the uterus the connection of the serous membrane with the muscular wall is so intimate that it is scarcely possible for rent of the peritoneum to take place without involving the muscular wall to a slight extent. When it occurs, some blood is often effused into the peritoneal cavity. Jacquemier describes splits and scars in the neighborhood of the Fallopian tubes and round ligaments, the result of mechanical distention. These, say Dubois and Pajot, do not appear to give rise to perceptible symptoms. They may be likened to the lesions of the skin from distention of the abdominal walls. But in the more severe cases of peritoneal laceration death may occur from shock, as in a case narrated by Clarke ("Trans. of the Soc. for Improvement of Med. and Surg. Knowledge"), where only an ounce of blood was found in the abdomen. Collins relates a similar case. It is probable that in such cases the lesion of the peritoneum was not the principal injury, but that it was rather an indication of severe sudden distention of the muscular coat.

[1] Monatsschr. für Geburtsh., 1868.

A more frequent cause of death seems to be hemorrhage, as in cases re-
ded by Ramsbotham and White.
There is a good specimen of peritoneal rupture in St. George's Museum.
Lacerations of the vagina have been carefully described by McClintock
Dublin Quarterly Journ. of Med." 1868) and by Scanzoni. There are
mplete lacerations. Tearing of the mucous membrane alone may happen,
l is frequent. The submucous tissue may tear and give rise to thrombus,
already described. Circular laceration of the upper zone of the vagina
been described. Spontaneous lacerations of the upper part of the
ina are often the result of extension of laceration of the lower segment
the uterus. The peritoneum behind, or the bladder in front, may be in-
ved.
We have already seen that, when a rent has begun in the upper zone of
vagina, it may easily extend under uterine contraction or manipulation.
d we must also bear in mind that transverse rupture of the posterior
l of the vagina has been caused by the sheer force of the expulsive
rts driving an ovarian tumor upon it, or the retroverted uterus in early
gnancy (E. Martin, Dubois, Schnakenberg, Grenser), and the non-preg-
t uterus (Fehling), or an extrauterine gestation-cyst (Thormann).
Rupture of the middle part of the vagina is rare. It can scarcely take
ce through its own contractions, since its contractile power is greatly
inished by distention during labor. It commonly occurs when the head
the pelvis, and is therefore probably caused by the action of the uterus,
er dragging the canal upwards from the impacted head, or driving the
d through the distended walls, as we have seen that an ovarian tumor or
gravid uterus may be driven through by the abdominal expulsive efforts.
lead, flaccid child would favor this accident, or a face presentation, or an
ipito-posterior position, in all of which there is a tendency to delay in
or, and to rolling back of the head in extension, thus stretching and
ising inordinately the posterior wall of the vagina.
Vaginal lacerations mostly take a circular form. They remain patulous.
l if the posterior wall is torn, the escape of the fœtus into the peritoneal
ity is frequent. Prolapse of the intestine is not uncommon.
Sloughing of the vagina may follow from the crushing and necrosis of the
ina under severe protracted labor with disproportion, whether instru-
nts have been employed or not. Injury of this kind might almost always
verted, did the opportunity offer of reducing the bulk of the child in
. Sloughing may terminate in gradual cicatricial closure of the vagina.
s actually obliterated, perhaps a minute sinus alone remaining to com-
nicate with the uterus. In such a case menstruation may be carried on
conception may take place. But when the obliteration is complete, if
nstrual activity be renewed, there will be retention above the cicatricial
um, and symptoms similar to those of retention from imperforate hymen
e. We have relieved such cases by operation.
ometimes the sloughing and consequent cicatrix involve the cervix uteri
well as the vagina.
The treatment during the sloughing stage consists in copious disinfecting
gations, and in counteracting the cicatricial contraction by wearing a
s's dilator or other form of vaginal-rest or pessary.
Laceration of the inferior third of the vagina always takes place in the pos-
or wall, and merges in laceration of the perineum. It is, in fact, a giving
of the pelvic floor or the lower or posterior valve of the parturient canal,
ich, in the expulsive stage, bears the chief strain of labor. This lacera-
n may be *central and perforative* or *vulvo-vaginal.* In a considerable pro-
tion of cases we believe the rent begins in the centre of the perineum,

then extends backwards and upwards into the recto-vaginal septum, and forwards through the commissure. In almost every first labor more or less laceration of the commissure or fourchette takes place. This is usually insignificant; but it is not unusual to find lacerations an inch in length, or extending back to the edge of the sphincter ani. As the parts recover from distention, these lacerations are reduced, and granulation often substantially repairs the injury. Occasionally, in spite of every care, the rent extends through the sphincter. In lingering labor the expansibility of the parts becomes impaired. Under the congestion and long compression the circulation becomes impeded, and, after a time, the tissue, half-necrosed, becomes as brittle as wet brown paper, yielding under the slightest force. Timely used, the forceps may, by anticipating this change of structure, and by giving a proper forward direction to the head, save the perineum. But, on the other hand, whether skilfully used or not, the forceps may cause laceration.

Rupture of the perineum, whether it occur under spontaneous or instrumental delivery, is not evidence of want of skill. Under instrumental delivery, which presuppose unusual difficulty, rent is *à fortiori* more probable. This is important to remember, because threats of legal proceedings to extort money have been based upon accidents of this kind.

Sometimes the rupture is limited to the central perforation. Duparcque measured the perineum as distended by the head. The length was 3.50 inches to 4.10 inches, the breadth 6 inches, being much more than its ordinary dimensions. It is, moreover, excessively thinned. If the head be large, firm, the perineum at all rigid, and especially if the coccyx retreat much backwards, or the pubic arch be narrow so as to oppose extension of the head round the symphysis, the perineum becomes enormously distended centrally, and is very apt to be perforated. The child has been driven through this perineal opening, the commissure being preserved intact, but more frequently the rent forwards is completed. The structures may also give way under stormy, tetanic contractions. We have seen a fistulous hole in the perineum remain after perforation. Lamb relates a case ("Amer. Journ. of Med. Sci.," 1856). The wound healed. Schmitt-Müller another ("Bayer ärztl. Intell-Blatt," 1865). The opening was closed by sutures; after suppuration it healed. Jarjavay[1] quotes from Jobert de Lamballe (1850) the history of a labor complicated with ovarian tumor. The head was kept back by the tumor; during labor the tumor was driven through the rectum and perineum. Luschka also reports ("Monatsschr. f. Geburtsh.," 1867) a case of an ovarian tumor which was driven out of the vagina.

Rent frequently begins at the vulvar edge from extreme rigidity. This may be prevented by timely incisions. *Laceration may take place at the anterior edge of the vulva.* Tyler Smith affirms this, quoting Robert Barnes's statement (1858). P. Müller ("Scanzoni's Beiträge," 1870) also describes this injury. In one case fatal hemorrhage ensued.

B. Hicks points out that the passage of the child's head in primiparæ will occasionally push before it the internal membrane of the perineum, so as to tear it, leaving a raw surface difficult to heal. On this Emmet[2] makes a similar statement. "The perineum is frequently torn on the vaginal surface, without the fissure extending to the skin; . . . a fold of vaginal tissue is pushed forward by the child's head. This laceration is deep enough to divide the central attachment of the ischio-perineal ligaments and leave the vaginal outlet flaccid." *The prophylactic treatment* turns chiefly upon the question of "supporting the perineum." For the discussion of this we refer to the chapter on "The Management of Labor." One point may be re-

[1] Traité d'Anatomie Chir., vol. ii. [2] Principles and Practice of Gynæcology.

"Support" should not be given until the head is undergoing

ılogy between rupture of the perineum and rupture of the cervix
ıt is, of the anterior and of the posterior valve of the parturient
striking. We may, by observing and studying the mechanism of
f the perineum—a phenomenon which takes place under the eye
—arrive at instructive conclusions as to the mechanism of rupture
ıus. The perineum certainly ruptures without being diseased. The
on is that the healthy uterus may do the same.

TO DO WHEN LACERATION OF THE PERINEUM OCCURS.—This
ıpon the degree of the laceration. The slighter rents commonly
ıiently if left alone. But there is a very potent reason for not
em quite alone. The raw surface may be a gate for the entry of
tter into the system. It must, therefore, if not closed, be kept
disinfected. This is best done by placing a pledget of lint soaked
on of chloride of sodium or carbolic acid between the edges of the
king care to press the lint well into the fork of the wound. And
perineum has been injured, it is desirable to cleanse the uterus and
disinfecting injections.

the rent has extended partly or wholly through the sphincter,
ıay still take place spontaneously. But, if the patient's condition
is better not to rely upon this prospect. Immediate reunion by
ıuld be practised. The recent tear seems as favorable to union by
ntention as a fresh raw surface made by the knife. And under
ı the operation is not difficult. If the operation be not done
enty-four hours, it will generally be wise to postpone it until after
from puerpery.

ıks makes an important practical distinction. He found these
ıal well after suture when the rent was quickly made through sound
t union failed if the rent had occurred after long-protracted labor,
rittleness of the tissues.

pregnancy, especially in the early months, *wounds of the vagina*
ı are frequently the result of *attempts to procure abortion*. Various
pointed instruments have been used. If unskilfully used, as is
case, puncture or laceration of the vagina or cervix uteri often
the attempt to pass the os. In other cases, punctures have been
ıetrating the cervix and the wall of the uterus, opening into the
cavity. In these cases, effusion into the peritoneum may end in
ı minor injury, perimetritis and pelvic peritonitis of an acute type
ıommon, and may also be fatal. The symptoms of abortion com-
t not necessarily, attend.

ATIC INJURIES INFLICTED FROM WITHOUT.—These may result
ıce inflicted through the abdominal wall or through the vagina
ı. Injuries inflicted through the abdominal wall are of endless

juries inflicted through the vagina or rectum are of more especial
interest. These may arise from the use of the hand or of instru-
low force exerted by the hand may cause extension of laceration
ıgun has been described. In cases where the structures are still
ı hand, unskilfully used, may begin a laceration. This is more
likely to occur in attempts to turn when the parturient canal is
ır narrowed by an impacted fœtus. If the labor with impacted
e been long protracted, the soft parts become brittle or friable from
n to the circulation, and then moderate force, even skilfully em-
ay easily result in laceration. The hand may also inflict injury in

attempts to force it through the cervix to detach a prævious placenta, or remove a placenta after the birth of the child.

Injuries inflicted during labor may or may not be a consequence of unskilful obstetric manœuvres. Not seldom it is very difficult to determine, even in the presence of the most severe and extraordinary injuries, whether accident—avoidable or unavoidable—or direct violence was the cause. They may have begun spontaneously, and have been extended by attempts, perfectly legitimate, and perhaps not unskilful, to complete delivery of the child or placenta, or to return prolapsed intestine. It requires the greatest circumspection not to commit one's self to an opinion which subsequent evidence may prove to be erroneous. It must sometimes be impossible to discover in the wound itself unequivocal proofs as to the mode of its formation.

Chiara says that in three years he verified 11 ruptures of the vagina, uterus, or uterine peritoneum; 7 of these were produced by attempts to turn when the shoulder was deeply wedged, and 4 under conditions not so unfavorable, and in the hands of operators whose skill could not be questioned.

Subperitoneal *emphysema* is sometimes observed in connection with rupture. Kiwisch and McClintock have noted it. It occurs chiefly in the lower segment, in front, and in the left iliac region. It may arise from air entering during intravaginal manipulation, or from decomposition of the embryo. Duncan explains it by the renewed "retentive power of the abdomen" when contraction of the uterus and bearing-down force of the abdominal muscles intermit. A kind of suction-force succeeds. Bayer[1] describes a remarkable case. The air penetrated along the psoas major muscle up to the right kidney, where the extravasation had become converted into foul pus and gas. He says Hecker, Dohrn, and Löhlein have related cases.

Wounds of the Perineum.—Severe injury of this part, if noticed before the descent of the head, is most probably the result of external violence. If known to have occurred during the delivery of the child, it would be difficult to prove that it was due to criminal malpractice, however strong the suspicion might be that it was due to unskilful treatment.

Injuries of the vagina mostly occur at the upper part. They may arise from the unskilful use of the forceps or perforator. The blade of the forceps may be forced through the roof of the vagina, and may thus penetrate into the peritoneal cavity and partially detach the uterus from the vagina. Wounds made in this way are almost always transverse; but so are most of the lacerations of this region which occur under the natural forces. Possibly the edges of the wound may show marks of bruising by the forceps.

The roof of the vagina has been pierced by the perforator. This accident is not so utterly inexcusable as may be supposed. A very projecting sacral promontory, occupying as it does exactly the place where the head ought to be, and presenting physical characters very similar to the touch, may easily deceive the inexperienced. Strict observance of the rules hereafter given for the use of the forceps and perforator will enable the operator to avoid these calamities. We believe the accident has happened from the use of bad instruments. Indeed, it must require an amount of skill beyond the average so to use some of the vile instruments still in vogue as to avoid their slipping and doing mischief under some circumstances of difficulty.

The *crotchet* may slip and tear the uterine wall, especially near the cervix. Jagged pieces of cranial bone detatched by the crotchet may inflict similar mischief. The obvious way of avoiding these accidents is to discard the crotchet, and to substitute the craniotomy forceps or cephalotribe. These instruments are far more effective, as well as safer.

[1] Archiv. f. Gynäk., xxi.

Laceration of the uterus or vagina may take place in the attempt to *detach an adherent placenta.* This is the more likely to happen when the uterine tissue is diseased. The operation should be done with great gentleness. It is better to leave portions adherent than to persist too strenuously in tearing them off. Mr. Dunn relates[1] a case in which rupture occurred with an adherent placenta. There is a preparation in University College Museum showing the same combination. This subject is considered under "Hemorrhage" and "Diseases of the Placenta."

The first danger in turning is encountered in the endeavor to get the hand past the presenting part of the child. If this be roughly done, the uterus may be partially torn from the vagina. If this danger be overcome, the uterus may be perforated in its body by the projection of the knuckles or by violent thrusting forwards of the fingers. These dangers are avoided by decapitation or other modes of bisecting the child. Upon this subject Denman says: "If the uterus be strongly contracted, it may be ruptured by attempts to pass the hand; but in this case a rupture could only happen when the force with which the hand was introduced was combined with the proper action of the uterus; for the strongest person has not the power to force his hand through a healthy and unacting uterus." We are not prepared to assent to this; and we must bear in mind that the uterine tissue in the cases postulated is likely to be softened. But we must admit that it is very possible to tear through the vagina, and also to rend the os uteri, whence the lesion may easily extend into the body of the uterus.

Symptoms, Course, and Diagnosis.

The symptoms and course will vary with the cause, extent, and seat of injury. The common signs are those of "abdominal shock," indicating severe intra-abdominal injury.

Rupture of the uterus during early pregnancy can hardly be distinguished from rupture of a tubal gestation-cyst. The subjective symptoms will be almost identical. We may arrive at a diagnosis by exploring the uterus with the sound, especially after dilating the cervix with laminaria-tents. We may thus find the uterus intact, and if its size be not much increased, we have additional evidence that the pregnancy was not uterine. There may be external hemorrhage in both cases, but this will probably be more abundant in uterine rupture.

The symptoms of spontaneous rupture or laceration early in labor, as commonly described, and as they occur in many instances, are: Sudden acute pain, with a sense of rending in the belly, sometimes attended with an audible snap, it is said; quick collapse, marked by pallor, fainting, extinction of pulse; vomiting; some hemorrhage externally, and the signs of anæmia from greater loss internally; cessation of uterine contraction. If the child be thrust wholly or partly out of the womb, the abdomen flattens somewhat; there is retreat of the presenting part of the child from the os uteri; occasionally prolapse of intestine in the vagina or beyond the vulva; great pain, especially on palpation over the abdomen, where irregular, hard projections are felt which may be identified as parts of the fœtus. If the effusion of blood be great, there is increased and distressing tension of the abdominal walls. Cramp-like or spasmodic pains follow. The flushed face becomes suddenly deadly pale; the eyes lose their brilliancy; the whole surface is covered with a clammy sweat; trembling of the limbs or repeated faintings announce a profuse internal hemorrhage. Presently, when reaction

[1] Obstetric Trans., 1868.

comes, the patient complains of feeling a warm fluid pouring out in the neighborhood of the groins and loins. She sometimes feels the movements of the child when it has escaped into the abdomen. But usually the child dies quickly.

It has, however, often been observed that the symptoms are not so strongly marked. Sometimes very little is complained of at the time when it was presumed that the injury took place. The collapse creeps on gradually. The woman may be even capable of walking about for some time. Denman reports such a case. We have noted one.

But sooner or later, almost always within two or three hours, collapse becomes pronounced and pain severe. The gradual development of the symptoms is explained in some cases by the gradual progress of the injury. The rent does not at one stroke attain its maximum. There is first a moderate rent, possibly not through the peritoneum, and without much effusion of blood. The rent extends, and blood and, perhaps, the fœtus are extruded. We must not, then, expect uniformity in the symptoms.

In many cases no decisive symptoms precede. It is prudent to look upon the signs of obstructed labor—that is, of dystocia—as the proper premonitory signs of rupture. Obstruction allowed to persist may lead either to rupture or to exhaustion. The following condensed report is full of instruction: In a case of occlusion of the cervix uteri the pulse rose to 140; crampy, painful contractions of the uterus set in; rupture seemed imminent. Incision of the cervix, allowing expulsion of the fœtus, brought almost instant relief.

The *symptoms of boring-through* under pressure and friction can hardly be distinguished from the extreme collapse and irritative fever which attend upon long-protracted labor. The perforation of the uterine tissue is only the climax, the last stage of long-preceding injury. The symptoms are gradually intensified. The patient dies of prolonged shock, exhaustion, and deteriorated blood.

Hemorrhage varies greatly in different cases. In some fatal cases scarcely any blood has been lost. This may be partly explained by the rupture having traversed parts distant from the cervix and sides of the uterus and the placental site; from the placenta itself not having been detached; and from the uterus having quickly contracted. There is usually little or no hemorrhage in the cases of gradual perforation or separation resulting from long compression.

The diagnosis of laceration *when the fœtus has been extruded into the abdominal cavity* is generally distinct. Parts of the child are felt by external palpation. The contour of the abdomen is distorted; it presents irregular prominences. The uterus may be felt contracted and shrunk down towards the symphysis pubis. But the most certain sign is obtained by passing the hand into the uterus, where possibly intestine may be felt coming down into its cavity, or even into the vagina, and the hole may be felt. In a case where the rent was anterior, the finger was felt protruded through the rent by the hand on the abdomen.

Where the fœtus is still retained in utero the diagnosis is less obvious. But here also there is generally some recession of the presenting part. The symptoms also vary according to the seat and degree of the injury. Laceration of the cervix, not extending to the uterus or vagina, may give rise to no marked symptoms. It may be a cause of secondary hemorrhage.

The *symptoms of laceration of the vagina* are usually less severe than where the uterus suffers. Premonitory signs are rare. The shock is moderate; vomiting is not constant; escape of the fœtus and placenta into the peritoneal cavity is more frequent (McClintock) than in uterine rupture. Prolapse of the intestine is not uncommon. But simple laceration, without expulsion of

d into the abdomen or prolapse of the intestine, may be fatal from
s in a case communicated to us by John Ray (1875).
rognosis is in a high degree unfavorable. The successive risks which
ect of rupture of the uterus has to run are: 1. *Shock.* This may kill
hours. 2. *Hemorrhage.* This acts more slowly. But shock and
ıage are often combined and act quickly; and secondary hemorrhage
inguish life, tottering under the first blow. 3. *Metritis, gangrene,*
ritis, peritonitis, diffuse suppuration, leading to, 4. *Thrombosis* and
ı. Psoas abscess was the cause of death in one or more of Collins's
5. *Blood-infection,* which may prove fatal at variable intervals, ex-
to days or even weeks. 6. In the perforative injuries there may be
g or *gangrene,* especially where the bladder is also involved. Roki-
states that the uterine artery has been opened by sloughs in the
giving rise to fatal hemorrhage. 7. The agglutination from inflam-
may obstruct the intestine and cause *fatal ileus.* 8. When *intestine*
ıe through the wound, it may become *strangled.* It is to be noted
several fatal cases, masses of blood decomposing were found in the
nal cavity.
apparently the most formidable do not exclude hope. Numerous
es are recorded of recovery even after the child extruded into the
n has been extracted by turning through the uterus. Some cases
en reported in which recovery followed although the child was left
abdomen. It may be doubted whether some of these cases were not
f extrauterine gestation. On the other hand, it is possible that the
ncapsulated by inflammatory deposits, has been after a time dis-
l on disintegration. Recovery where the child is not cast into the
nal cavity is more frequent. A moderate quantity of blood in the
eum may form a hæmatocele, and the uterine wound may heal. Peri-
in such a case becomes a conservative process; and the uterus may
t adhesions with the abdominal wall. The uterus, contracting, retreats
pelvis; the wound either closes by a scar or may remain unclosed in
ıe opening being shut off from the peritoneal cavity by adhesion to
lominal wall.
ality, as deduced from statistical tables, must necessarily be untrust-
. Cases that have been subjected to treatment, good and bad, or to
all, are cast up together. There is, however, as we have seen, ample
e to prove that recovery has happened even from the severest injuries
nplications. This is the all-important point, since upon it we base
e of successful treatment. There cannot be a reasonable doubt that
ves might have been saved had the cases been treated according to
ıt of actual knowledge, and especially by laparotomy, the removal of
ld, and then of the uterus by Porro's operation. The prognosis in
ure is assuredly better than it has been in the past.
prognosis in laceration of the vagina varies with the seat and extent of
ury. Large lacerations in the upper zone are most dangerous, often
But in rents in the middle zone and in the pelvic floor, especially the
there is a fair prospect of recovery. If the rent involve the bladder,
gnosis is more serious.
ts confined to the vaginal portion of the cervix, or at least not extend-
the os internum, are not often fatal, unless it be by immediate or
ary hemorrhage, or by favoring septicæmia. When the rent runs up
vaginal roof so as to trench upon the broad ligament, pelvic cellulitis
Emmet has well shown, a very probable consequence.
Treatment.—The *prophylactic treatment* resolves itself mainly into the
ement of dystocia. Bearing in mind the cardinal fact that in the vast

majority of cases rupture begins at the cerxix, whenever we find the cervix unduly tense, not dilating before extreme pressure, when thinned to the utmost and long compressed, we have a strong indication either to diminish this pressure by lessening the head, or to supplement defective dilatation by incisions in the cervical ring.

The *remedial measures* will be governed by the nature of the case. To take the first case: *The child, or at least the presenting part, remains in the uterus or vagina.* As a general principle, the indication is to deliver. This admitted, the question remains as to the best mode of delivery. To rally the patient from shock, it is wise to administer a drachm of ether by subcutaneous injection, to empty the bladder; and generally anæsthesia should be induced by ether inhalation. If the head present, if the cervix be expanded, and there be no marked obstruction from pelvic deformity or other disproportion, the delivery may be accomplished *per vias naturales*, by forceps. An assistant should grasp the uterus between both hands during the extraction. When the child is delivered, even greater care is required in the removal of the placenta. The cord must be tracked up to the placenta, and the greatest possible circumspection will be necessary in order not to mistake this body for anything else, and to avoid dragging down intestine along with it. Although the presenting part of the child may not have escaped into the abdomen, the placenta may have done so. The cord then may guide the operator's fingers into the abdominal cavity, where the placenta may be surrounded by floating intestines. The wound has probably retracted, and the return of the placenta through the diminished aperture may be impossible without the exercise of dangerous force. The cord may break off, and the placenta be left loose amongst the intestines. Shall we search for it there, by thrusting the hand through the rent in the uterus? No! There is a better way, which will presently be described.

Take the next case: *Obstruction from disproportion or malposition.* It is better to perforate the head and to deliver by craniotomy. If the child present transversely, decapitation or bisection of the trunk is far preferable to turning, which is almost sure to involve extension of the injury. Indeed, looking to the slender chance there is of delivering a live child, it will generally be better to deliver by craniotomy, even when there is no disproportion. The child quickly dies after the shock of the rupture.

The third case: *The child, with or without the placenta, has been cast into the abdominal cavity.* Sometimes the ovum entire has been cast into the abdominal cavity. If the rent be in the vagina, it may not be difficult to remove the child by the hand passed through the rent; and success has several times followed the removal when the rent was in the uterine wall. Ingleby relates a successful case. Danyau, Bell, of Bradford, Duparcque, also relate successful cases. On the other hand, the failures to remove the child and placenta by this method are numerous. Success can at best be looked upon as a rare and fortunate accident. Even when child and placenta are removed the operation is imperfect. Clots of blood remain, and more blood is apt to be poured out from the wound. The operation itself is full of danger. The injury may be increased; the shock is intensified. Many women have died under the attempt.

Actual knowledge leads us to consider two other operations as offering a better prospect for the mother, and as giving a chance for the child. These two operations are—(1) *laparotomy simple*, and (2) *laparotomy supplemented by the removal of the uterus*—in other words, Porro's operation.

1. Laparotomy Simple.—This operation consists in making an abdominal incision from about two inches above the umbilicus down to within three inches of the symphysis pubis, and extending it if necessary. When

nen is laid open, the child and placenta are removed and clots way. The peritoneal cavity is sponged out with carbolized water; ıe cavity is cleaned out in like manner; and if the uterus be well d, it may be left to heal by itself. If flaccid, and the wound gape, closed by catgut or silk sutures. We have in fact completed a section of which Nature has done half.

vantages of this operation over extracting by the vagina are mani- ere is little danger of further lacerating or injuring the uterus or the offending fœtus, placenta, and blood are easily and completely from the abdominal cavity; the uterine cavity can be cleaned out; ge from the placental site can be staunched by styptic swabbing; ge from the torn edges of the uterine wound can be stopped by ıe wound by sutures. A fair success has attended this operation. ases in which we performed it very sensible immediate relief ap- be gained; the shock seemed diminished; the pulse recovered l we were satisfied that life was prolonged. In both cases the was delayed some hours. When death follows, it may be difficult to the original injury and to the operation their respective shares ult. But, looking to the history of ovariotomy, to the exploratory made without completing ovariotomy, we are justified in regarding tion itself as of comparatively small moment. It is the original at kills. If we fail to save the woman from her extreme peril, we comfort in the reflection that we have done the best that art and suggest.

's Operation.—The other alternative, that of proceeding after ny to remove the uterus, includes all the advantages of simple ny with additional security against hemorrhage, and the special e of removing the injured organ, which, if left, might be a source r, immediate and remote. It is surely desirable that a woman who survived rupture of the uterus should be secured against the y of having again to run so great a hazard.

eration will be found described under the "Cæsarean Section."

dson collects six cases in which Porro's operation was performed ture of the uterus. The mothers all died. But this result cannot e attributed to the operation. In all cases the child was dead before tion.

Complication with Prolapse of Intestine—history, diagnosis, agement. Intestine may be protruded by the natural expelling it may be dragged out accidentally, or through recklessness, or by ntangled in the limbs of the child. We may next inquire how l what portions of the intestine can be protruded spontaneously? ries of cases given are wanting in precision upon these points, but more than six feet may be thus driven out, and we are not justified g that very much more may be driven out. The force required to intestine is really very small. The intestines are retained *in situ* packed in a closed bag. The mesentery is not wanted to suspend is a delicate membrane, the chief use of which is to carry blood- ymphatics, and nerves. When the bag is opened the intestines ape. This is constantly seen in ovariotomy. Any one who has a post-mortem examination must have been struck with the facility ch the body is disembowelled. Robert Barnes instituted experi- demonstrate the force required to drag out intestine. The mesentery tached at one point of the small intestine, a two-pound weight was to the coil; it quickly ran down to the ground carrying intestine he mesentery offering but slight resistance. Braxton Hicks and

Goodhart subsequently made similar experiments at Guy's Hospital, and obtained similar results. Now, the expulsive force of the abdominal muscles must exceed two pounds. It is incontestable that it must equal the weight of the child, for the abdominal muscles alone may expel the child and the uterus along with it. An approximate idea of the power of the abdominal muscles, even in a delicate woman, may be obtained when we attempt to grasp the uterus through them to express the placenta. Not seldom, contraction so powerful is excited that the hands of a strong man, using his utmost strength, and putting his weight into the effort, are thrown up from the uterus. In a case of laparotomy, a solid tumor weighing 28 lbs. was thrown out of the abdomen by the mere force of the diaphragm under vomiting. Without insisting upon the experiments and calculations of Dr. Haughton, already referred to, we are satisfied that the expulsive force is not overstated at fifty pounds.

A case related by Fehling ("Arch. f. Gynäk.," 1874) is a distinct illustration of the simple action of the expiratory muscles in expelling intestine. The subject, a pluripara, aged 63, had suffered from a reducible prolapsus vaginæ for thirty years. Carrying a bucket of water up steep steps the womb came down. She tried to replace it, using some force. She felt something give way, and intestine protruded, forming a mass as large as a man's head. The intestine was traced back into the abdominal cavity through a large rent in the posterior vaginal wall. The woman died in eleven hours from shock. Dr. Fehling informed us that the amount of intestine protruded was probably over twelve feet.

It is commonly said, and it is, indeed, sometimes true, that rupture is quickly followed by paralysis of the uterus. But we must be careful to qualify this statement. The uterus frequently contracts forcibly after the analogous injury inflicted by Cæsarean section; and, as a matter of observation, it also contracts after spontaneous rupture. If it did not contract, how are we to account for the cases of recovery? It is because the uterus contracts that prolapse of the intestines is not more frequent. The uterus, like the heart, has an inherent contractile power. It has been known to contract after being almost entirely separated from its attachments, and even after death. Bandl says he almost always found the uterus contracted.

The recession of the presenting part and the apparent arrest of labor observed on rupture taking place are not absolute evidence of uterine paralysis. They rather prove that the uterus no longer acts in driving the child forward in the natural course.

What may Happen if Protruding Intestine is not Returned?—1st. It may be gradually reduced by spontaneous processes. This we have seen ourselves. Cases are not rare. 2d. It may get strangled in the uterine wound, inflammation and gangrene supervening. Deneux quotes a case. Recovery has been known. In McKeever's case, four feet of intestine sloughed away, and recovery ensued. An artificial anus may form, as in a case seen by Roux (see Duparcque).

The Diagnosis.—It is a matter of great clinical interest to know the possible sources of error in diagnosis and consequent error in practice in cases of this kind.

1. *The Placenta.*—A child may have been delivered and a placenta has followed. Another placenta may be felt in the vagina or uterus. This would naturally lead to the conclusion that there was another child; and as none might be found in the uterus, it would suggest the inference that there was rupture and escape of a child into the abdominal cavity. We have been called to such a case. The second placenta was *a placenta succenturiata*. There was no rupture and no second child.

A rupture may have taken place. The child may have been delivered ally or artificially, and the cord tied. In searching for the placenta, ng the cord, the hand may be guided through the rent into the inal cavity, where the placenta may have been cast by the uterus. ve have known.

A more or less *solid blood-mass* may present or be felt *in utero* after the of the child. Such a mass may easily be mistaken for placenta, gh no cord be attached to it. Such a mass, surrounded by membranes ers of fibrin, may even to the eye resemble the placenta. And such a nay come from the abdominal cavity, as in a case published by Robert s in "St. Thomas's Hospital Reports."

Substances other than a child or placenta may be protruded from the . A *fibroid tumor or polypus* may be thrust out after the child has born. It may be taken for the placenta or a firm clot. It is a most ng complication, not unlikely to be attended by rupture.

An abnormality of the fœtus, which might be seriously embarrassing, is d in the "Obstetric Operations," 3d ed. The preparation is in omas's Museum. It shows a sacro-coccygeal tumor that might easily taken for a placenta.

An ovarian tumor may be driven through a rupture of Douglas's sac Dr. Dunn's case ("Virginia Medical Monthly"), and in one by Mr.

Omentum may be mistaken for placenta or the membranes. Braxton relates such a case ("Lancet," 1875). He was called to what was ented as "a curious modification of the placenta." It turned out to entum protruding through a rent.

Intestine may come down into the vagina or outside. But this is not arily proof of rupture. The intestine may belong to a child *in utero*, rmed, having no abdominal wall, as in a case reported by Dr. Sheehy t. Med. Journ.," 1875); in one by Dr. Meadows ("Obst. Trans.," vol. and as in a specimen in St. George's Hospital Museum. Or the fœtal ben having burst from decomposition or from over-distention from , the intestines may have fallen through. Fœtal intestines are smaller those of the mother; but the difference may well escape detection by ho in all probability has never felt either the one or the other before.

Maternal intestine, then, may be mistaken for fœtal intestine. And for else? It has been mistaken for *umbilical cord*. This, it is said, ought occur. It is easy to be wise after the event. We are all under the ion of habit. We believe the sun will rise to-morrow because it has so every day hitherto. The obstetrist, who has never felt anything else nacenta or cord in the vagina, is instinctively led to conclude that any- he feels there which bears *to the touch* (he is generally precluded from) any resemblance to them is placenta or cord.

ere are points that may, however, if critically weighed, lead to differ- ion. The cord, after division from the child, is a single string; there cut end outside, there is no mesentery; it is tolerably firm, not inflated ; traced up, it leads to the placenta. On the other hand, the intestine ollow tube forming loops or coils; it has an elastic feel less firm than rd; traced up to its source, it does not lead to the placenta, but through into the abdomen, to its inner border. These differences are generally ed enough to enable an experienced man under ordinary circumstances, e full possession of his faculties, and retaining his delicacy of touch, by sight, to distinguish one from the other. But the circumstances *e necessitate rei* extraordinary. The cord, even after being divided, may loops in the vagina, the cord being carried back into the vagina in

searching for the placenta, or lost in clots of blood. If the cord be unusually long—we have known it to be five feet long—loops and coils are easily formed; and a coil of cord of a second child may come down, there being no free end. Then as to the feel. Some cords are as thick as intestine, as in a specimen in St. George's Museum, so resembling intestine as to deceive both eye and finger. Further illustrations of this, one of the most trying situations in obstetric practice, will be found in the "Obstetric Operations."

Experience has brought us this conviction, that before condemning a surgeon or a midwife for mistaking intestine for umbilical cord, or omentum or clot for placenta, we must calmly weigh all the possibilities of error, and make due allowance for the unexpected and rare event of intestinal prolapse. We do not hesitate to say, with all the emphasis that personal observation and extensive knowledge can justify, that those who are most ready to condemn such an error are those whose experience is the smallest.

If intestine protrude through the wound, attempts may be made to return it. This is sometimes extremely difficult, if not impossible. As fast as you push up one part another comes down. Expulsive reflex action is set up, so that the very effort you make to return intestine excites to the expulsion of more.

When the rent is in the posterior wall of the vagina, the difficulty in returning the intestine and in keeping it from coming down again is greater. The opening remains gaping, and all expulsive action bears directly upon it. It has occurred to some that the opening might be stitched up. We do not know that this proceeding has ever been executed. At least we do not know of a published or authenticated case.

An easier proceeding would be to open the abdomen, to draw back the intestine, and then to stitch up the wound. But still, the best plan would be to perform Porro's operation—an operation which leaves nothing undone.

During collapse perfect rest is absolutely necessary. The flagging energies may be sustained by repeated subcutaneous injections of ether; and beef-tea enemata containing brandy will also be useful.

E. INJURIES OF THE PELVIC JOINTS, LIGAMENTS, AND OTHER STRUCTURES.—The softening of the joints in gestation and parturition has been discussed (p. 129). Occasionally, under the simple excentric pressure exerted by the fœtus upon the pelvic girdle, inflammation of the joints is caused. This is more frequently noticed in the pubic symphysis. This may proceed to abscess. But more formidable injuries result from the use of instruments, especially of the forceps. It would not be altogether justifiable to affirm that such injuries might always be avoided. But certainly, if the forceps be only used in proper cases and with due skill, observing axis-traction, they will be extremely rare.

Contracted pelvis will be a predisposing cause. The symphysis pubis bears the chief brunt of violence during instrumental labor, vicious traction telling most upon the anterior wall of the pelvis.

The subject has been well studied by Ahlfeld ("Die Verletzungen der Beckengelenke während der Geburt und im Wochenbette." "Schmidt's Jahrb." 1876).

Injury to the pelvis is not limited to the joints. Instruments may so contuse the last lumbar and upper sacral vertebral bodies and the interarticular cartilages that necrosis follows. The bones have been bared by the laceration of the covering soft structures. But in some cases the cartilages have been injured, the peritoneum remaining intact.

Injuries of the bladder and urethra may be produced under the pressure and contusion arising during labor, chiefly where there is disproportion; or from crushing by instruments, most frequently the forceps. The anterior wall of the pelvis bears the chief brunt of the vicious force in labor. In

using the forceps the edge of one blade is apt to come forward towards the symphysis, and the ordinary forceps often demands the highest skill in so directing traction as to diffuse the pressure equally on the pelvic girdle.

The bladder may burst from over-distention, as in retroversion of the gravid womb. This has been adverted to in the section on this condition.

J. Ramsbotham relates the case of a woman, aged 36, in whom, after protracted labor and retention of urine, a hole, the size of a finger, was found in the uterus; peritonitis ensued. This may be regarded as a case of simple intraperitoneal rupture.

T. E. Rawson[1] relates a case of a woman who, a month after labor, had sudden collapse—a small ulcerated opening was found at the summit of the bladder. Hey relates a similar case. The woman died on the eighth day after labor attended by distended bladder.

Rupture during labor is described by Velpeau and by Blundell.

The bladder may be directly torn during delivery by the forceps, as in a case which happened recently in London. The patient died, after sewing up the wound. This case, so far as we know, is unparalleled.

Faye relates a case[2] in which the bladder was ruptured under the use of ergot for obstructed labor from an arm presentation.

Much valuable information upon this subject will be found in the excellent monograph of Walter Rivington "On Rupture of the Urinary Bladder," 1884.

The practical lessons to be drawn from these catastrophes are obvious.

Vesico-vaginal fistulæ are more commonly the result of necrosis of the tissues of the septum than of laceration at the time of labor. In the majority of instances it is only after several days that urine is observed to escape by an abnormal opening in the bladder or urethra—that is, after the slough of killed tissue has come away. In the meantime there is likely to be paralysis of the bladder, compelling resort to the catheter.

For further information upon this subject reference is made to the "Clinical History of the Diseases of Women." The chief obstetric interest lies in determining how to obviate this evil. This depends almost entirely upon attention to two points—first, to watch against protracted labor, which involves long pressure upon the soft parts engaged between the child—especially the head—and the pelvic wall; secondly, to use due care in the use of instruments, so as not to bear unduly upon the same parts.

Recto-vaginal fistulæ are more rare. Their history is similar, but from the posterior wall of the vagina being less exposed to crushing between the child and projecting bone than is the case with the anterior wall, when this lesion occurs it is more likely to be the result of direct injury.

E. INVERSION OF THE UTERUS.

Acute and Chronic; Spontaneous or produced by external force; How Produced; John Hunter's Theory; Crosse's; Lazzati's; Three Degrees; Course; Treatment.

Inversion of the uterus is an accident of labor which may most usefully be studied in connection with rupture. In the suddenness of its occurrence, in its instant danger, in the call for prompt recognition and remedy, in its occasional complication with rupture or laceration, and in its medico-legal relations, it has many points of connection.

[1] Lancet, 1843-4.

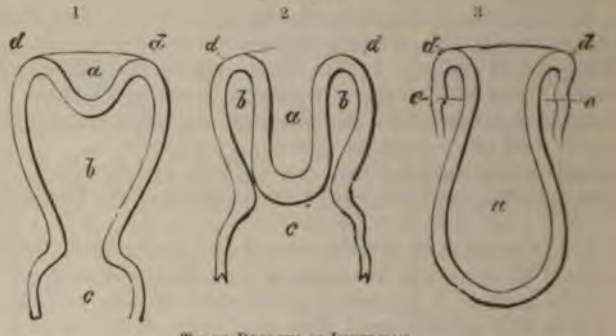
[2] Schmidt's Jahrb., 1860.

DEFINITION.—Inversion may be simply defined as a turning inside-out of the womb. (*Inversion, rovesciamento, Umstülpung.*) The fundus falls through the cervix, coming out at the os externum, so as to form a new cavity, the lining of which is the external or peritoneal coat of the uterus.

Inversion may be *complete* or *partial*. Crosse describes *three degrees* (see Fig. 161—(1) Depression; (2) introversion; (3) perversion or complete inversion.

Inversion is *acute* or *chronic*. The true distinction was defined by Robert Barnes.[1] Acute inversion ends with the complete involution of the uterus. When this process is complete, the case is chronic. The distinction is based upon the important physiological fact that, whilst involution is going on, the

FIG. 161.



THREE DEGREES OF INVERSION.

1. DEPRESSION. 2. INTROVERSION. 3. COMPLETE INVERSION. (CROSSE.)

a. Fundus of uteri. *b, b*. Cavity of uteri receiving inverted fundus. *c*. Vagina. *d, d*. Mouth of inverted portion.

muscular walls still retain active contractility, the organ is larger, and the cervix is comparatively yielding. During this stage the parts are more yielding and reduction comparatively easy. The history of the chronic form is traced with care in the "Clinical History of the Diseases of Women." Our present concern is limited to the recent or acute form of the accident. We introduce an illustration of the chronic form in order to give a correct idea of the relation of the parts (see Fig. 162).

Inversion, like rupture, may be *spontaneous* or produced by *external violence*.

FREQUENCY.—The accident is so rare now-a-days that many men of large experience have never seen it. In former days it was not uncommon; and this may still be said to be the case in countries where obstetric practice is largely in the hands of women. Like other of the great catastrophes of midwifery, it has become rare in proportion as the art has improved. Thus it is all but unexampled in the records of the Dublin Lying-in Hospital. It is, in fact, such a rare accident that it is impossible to give any statistics relative to its frequency which could be said to be trustworthy. Ruysch tells us that it was not uncommon in Holland in his day, when midwives were generally employed. Denuce[1] collected 330 cases of inversion.

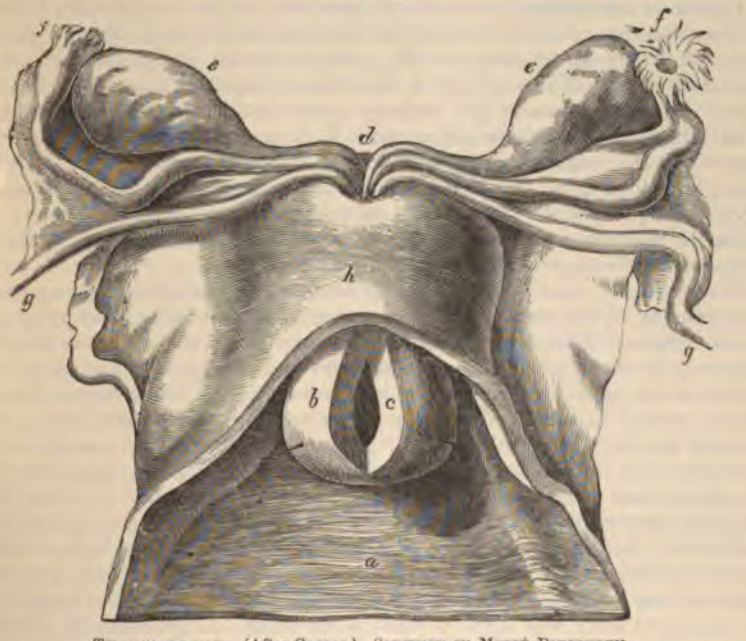
But although, as a general rule, it may be true that the frequent occurrence of inversion is indicative of bad practice, it would be wrong to apply this absolutely. Now and then instances occur, and will occur under skilful hands, and when approved principles of conduct have been sedulously observed.

[1] Samuel Cooper's "Surgical Dictionary," Samuel Lane's edition.
[2] Inversion de l'Utérus, 1883.

We must, therefore, carefully study the modes in which inversion—spontaneous, or induced by external violence—is brought about.

The following circumstances have been noticed in the histories of cases of inversion associated with labor: 1. It has occurred almost always, if not invariably, immediately after the expulsion of the child, and during the delivery of the placenta. 2. In a large proportion of cases the accident followed pulling upon the cord, or other forcible attempts to deliver the placenta. It occurred in one case, which came in the chronic stage into St. George's Hospital under Robert Barnes's care, under manual "expression

FIG. 162.



TWO-THIRDS SIZE. (After CROSSE.) SPECIMEN IN MUSEÉ DUPUYTREN.

a. Vagina. b. Inverted fundus incised at c to show its cavity. d. Point of inversion, with round ligaments, tubes, and ovarian ligaments drawn in. e, e. Ovaries. f, f. Fimbriated ends of tubes. g, g. Round ligaments. h. Cervix covered by peritoneum.

of the placenta." Other similar cases are reported, and several histories state that inversion occurred during strong pressure upon the abdomen. 3. In other cases the cord is noted as having been unusually short or twisted round the child's body, so that undue traction would be exerted on the placenta during the expulsion of the child. 4. In some cases there was adhesion of the placenta, and efforts to detach it have been followed by inversion. 5. In some cases, where there is no mention of the placenta having been meddled with, the delivery was very rapid. 6. In some cases the labor was natural but slow, characterized by inertia. 7. It has occurred in primiparæ as well as in women who have borne many children. 8. Delivery in the erect posture has in several cases been attended by inversion. 9. It has happened after delivery by forceps and ergot. 10. A frequent attendant condition, the placenta being still in utero, has been hemorrhage.

It will be observed that some of the foregoing conditions, if not all, imply inertia or flaccidity of the uterus, and that others give evidence of a *vis á*

tergo pushing the uterine fundus down, or of a *vis à fronte* pulling it down. Indeed, both these conditions mostly concur.

INVERSION DURING PREGNANCY.—Dr. Woodson relates a case which occurred at four months[1] and Dr. John A. Brady[2] one which followed abortion at five months. Both recovered after reposition.

Inversion has in a considerable number of cases occurred in the non-pregnant state, so far as we can learn, from the dragging or expulsion of a tumor. The history of this class of cases is studied in the "Clinical History of Diseases of Women." There is a good specimen (Hunterian) in the College of Surgeons. The case formed the basis of John Hunter's theory of the production of inversion.

Causes or conditions under which inversion has been observed. The fact of inversion has not seldom escaped detection at the time of its occurrence. It undoubtedly takes place in the great majority of instances during the placental stage. But, not having been observed at the time, some have supposed that the uterus might undergo spontaneous inversion hours or days after labor. Ané, Baudelocque, and Dubois cite cases. This hypothesis rests upon the negative fact that no inversion was observed at the time of labor, and then upon the positive fact that an inverted uterus was found at some subsequent date. This kind of evidence is hardly satisfactory. It is probable that in some cases there was partial inversion at first, and that inversion was completed gradually subsequently.

The essential conditions for the production of inversion are considerable enlargement of the cavity and relaxation of the whole or part of the walls of the uterus. When the uterus has contracted, its walls are so thick, and its cavity is so reduced, that, the anterior wall being flattened close in contact with the posterior, inversion cannot take place. The extreme flaccidity of the uterus has been distinctly described by many observers. Thus Smellie relates a case told him by Lucas of a woman whose uterus, after inversion, was immediately reinverted. It was "like a piece of tripe." The uterus has even been inverted after post-mortem delivery. In "Guy's Hospital Reports," 1864, Alfred Taylor relates a case communicated by M. Bedford, of Sydney. A woman, aged thirty-seven, died in labor with her seventh child. She had had violent pains, but it was clearly ascertained that the head, although low down, had not been extracted. Inspection of the exhumed body was made a week after death. The abdomen was much distended by decomposition. A male child was found between the woman's thighs. The uterus was inverted, and, with the placenta attached to it, was also outside the vulva. There was also a rupture of the uterus a little above the cervix, transverse, and about six inches long. The conclusion arrived at was that the rupture occurred during life, and was the cause of death, and that the expulsion of the child and inversion of the uterus were caused by the pressure of gases in the abdomen. The uterus was flaccid.

Hemorrhage is a disposing cause. Whoever has had his hand in the cavity of a uterus powerless through loss of blood, who has felt its flaccid walls yielding to every pressure "like tripe" or wet brown paper, will understand how easy it would be for such a uterus to be inverted. Indeed, we have often felt partial inversion taking place whilst endeavoring to detach adherent placenta by the fingers. Lazzati distinctly says that the uterus is inert at the time of inversion. Whilst in this state dragging upon the placenta may easily pull down the fundus and turn the uterus inside out; or pressure upon the fundus from without, as by the hand forcing it down, or by the expulsive action of the abdominal muscles, voluntary, reflex, or

[1] Amer. Journ. of Med. Science, 1866. [2] New York Med. Times, 1856.

in the act of vomiting, may drive the fundus down, and even through the os uteri.

We may, then, have spontaneous and artificial inversion during an entirely *passive state of the uterus.*

It is certain, however, that the uterus may be inverted by a *spontaneous active self-inversion.* The process was described by John Hunter. A polypus had grown from the fundus uteri. A ligature had been applied near the attachment. The tumor had sloughed off just before the patient died. Hunter described the case under the title of "Intussusception," to which he likened inversion. "The uterus," he says, "is liable to inversion from two causes: one is immediately after labor, when it is so large as to admit of its containing itself, and which is commonly from an imprudent mode of disengaging and bringing away the placenta, when that substance has been attached to the fundus of the uterus. The second is somewhat similar—namely, the expulsion of an adventitious body—although of another kind, and at a very different period in the state of this viscus. It begins to take place when this viscus is small, but becoming gradually large enough to admit of an inversion; so that, in the first case, the uterus is first large, so as to admit of an inversion, and by its contraction to its natural state, as it were, fixes it. This is done immediately, because its cause is immediate, for this enlarged state of the uterus is of short duration; but the second is gradual, because it is to produce itself by the very action of the uterus in expelling an unnatural body (such as a polypus). The polypus, as it grows, will gradually fill the cavity of the uterus, and the uterus will be constantly endeavoring to remove it. The action of the uterus will be downwards, and as the body of the uterus acts on its substance it will be gradually squeezed down towards the os tincæ, and the fundus will, of course, be drawn gradually into its own cavity, and as the polypus is squeezed down so will the fundus follow. When the whole length of the polypus has got into the vagina, if it has no length of neck, then will the fundus uteri be as low down as the os tincæ, the upper half of the uterus just filling the lower half; but I conceive it does not stop here. I conceive the contained or inverted part becomes an adventitious or extraneous body to the containing, and it continues its action to get rid of the inverted part, similar to an introsusception of an intestine." It is remarkable that in the subject of this case an introsusception of the small intestine coexisted.

We have quoted this description at length because it contains the germ of most subsequent theoretical explanations. A similar theory was set forth by Crosse, who also points out that one of the most constant conditions is attachment of the placenta to the fundus uteri. Denman also says that, if a disposition to an inversion be first given by the force in pulling the funis, it may be completed by the action of the uterus. Tyler-Smith seized the same idea, and expressed it in his usual lucid manner.

An important factor has been insisted upon by Rokitansky. Inversion begins at the placental site. This part, says the great pathologist, is liable to paralysis, and, being thicker than the other parts of the uterine wall, forms a projection into the cavity. That is the first step; the first postulate of Hunter. Then, if the placenta adhere, and be dragged upon by the cord from below, or if the abdominal walls act as in a bearing-down effort, the part already disposed to fall inwards is forced further down into the cavity. The external cup-like depression—Crosse's first stage (see Fig. 161, 1)—formed by paralysis of the placental site, may be felt by examination through the abdominal walls, and especially is this the case if traction be made upon the cord, the placenta adhering. When things have gone thus far, the whole body of the uterus being at the time inert, a little further pressure or drag-

ging brings the fundus down upon the cervix—Crosse's second degree, or *introversion* (see Fig. 161, 2). If this part be contracted, it may prevent the fundus from slipping through; or, the pressure continuing, the cervix may yield and allow the fundus to slip through, as it does in the ordinary labor, or in the converse case of artificial reposition; or the advancing fundus may find the lower segment and cervix flaccid, and offering no opposition. Indeed, the cervix is very liable to temporary paralysis after labor, and especially is this the case when it is lacerated. Accordingly, it has been observed that some cases have occurred gradually, others suddenly.

It may be supposed that the uterine ligaments would offer sufficient resistance to obviate spontaneous inversion; and the inference from this assumption would be that inversion must be the consequence of direct violence. But in reality this resistance is easily overcome. During gestation the ligaments become elongated, so as to be easily drawn into the hollow or cup formed by the inverting body of the uterus. The moorings of the fundus are too slack to keep this part up; but, on the other hand, the connections of the cervix, to its ligaments, to the bladder and vagina, hinder the inversion of this part for a time. And Casper says laceration of the ligaments may attend spontaneous inversion of the uterus. Hence one explanation of the greater frequency of the first two stages of inversion.

We may, then, upon these data, summarize the conditions for inversion. We find, 1. That inversion may be spontaneously produced by the driving force of the abdominal muscles, aided, perhaps, by the dragging force of the placenta, pushing or pulling the paralyzed and bulging fundal placental site

FIG. 163.

A NEARLY COMPLETE INVERSION OF UTERUS IN RECENT STATE, THE PLACENTA REMOVED. ONE-THIRD SIZE. (DR. CHAMBERS'S CASE.)

The Fallopian tubes and round ligaments are hanging out of the infundibulum formed by the inversion. The rough surface at the lower part is the placental site. A secundipara æt. 27. Half-an-hour after child's birth hemorrhage set in, the placenta being not yet expelled. The midwife pulled upon the cord; the patient had severe abdominal contraction, uttered a violent shriek of pain, and a round, ovoid body protruded from the vulva. The patient was moribund when seen. No opportunity for replacement.

through the relaxed cervix, or artificially produced by pushing upon the fundus, or by pulling upon the fundus by traction upon the adherent placenta. In these two forms, paralysis of the entire organ is the essential condition. 2. We have not absolute inertia, but paralysis of the fundal seat of the placenta. With depression, this part, as Hunter and Tyler-Smith explained, is caught in the lower zone of the uterus, and, exciting it, as a foreign body or polypus, to act, the introcedent part is driven down through

. In a similar manner, the first stage of depression or introcession artificially by traction upon the cord, or by pushing as in "ex- when the introcedent part is caught by the lower segment of the expelled. Duncan and Taylor, of New York, point out that, in nces, inversion begins at the cervix, which is rolled out or everted erincumbent pressure of the body of the uterus.

mptoms and Diagnosis of Recent Inversion.—The symptoms are se of shock, indicating sudden severe injury. They vary with the l progress of the inversion. Thus, the first degree or simple *de-* see Fig. 161, 1) may be unattended by pain, and be indicated hemorrhage and a corresponding depression of the vital powers. rrhage comes from the relaxed projecting placental site. As the roceeds and becomes *introversion* (see Fig. 161, 2), urgent symp-, according to the degree of compression exercised by the unin- tion upon the inverted portion. A sense of fulness, weight, as of to be expelled, is felt. The woman has thought another child g, or that the placenta was coming. Expulsive efforts, uterine inal, sometimes very violent, follow. Hemorrhage is not constant. nat, when the inverted portion is firmly compressed, the hemor- rrested, and that bleeding is a mark of inertia. When there is morrhage is often profuse and continuous. When the inversion is pain and collapse are aggravated. Clammy sweats, cold extremi- ing, alarming distress, restlessness, extinction of pulse follow.

the expulsion the woman has often exclaimed that "her body has or that the attendant "is tearing away her inside;" and this even ne may have been touching her. Perhaps convulsions set in, but consciousness is retained.

examination is made, the appearance of an unusual mass is ob- side the vulva. This may be as big as a child's head, or bigger. sex Hospital Museum is a specimen as large as the adult head om the vulva. There was also rupture, both said to be produced lwife pulling upon the cord. The depending mass is fleshy, firm, pyriform, dark red, bleeding, probably partly obscured by blood- e cord, if the placenta had not previously come away, and if the ot been torn off, will be hanging from the mass, and, being traced oot in the placenta, may give the impression that it is placenta g more. Under the influence of this impression, the first impulse seize the mass and try to remove it; and the profuse attendant ay add urgency to this impulse. But deliberate examination will the hand cannot be passed up beyond the presenting mass or pre- centa into a cavity like the vagina or uterus; the hand is arrested the root of the mass by a groove low down in the pelvis, or even vulva; feeling above the pubes for the uterus, it is not found ught to be, but the hand sinks in, carrying the flaccid wall before ck to the spine, and even into the pelvic cavity. The uterus, t where it ought to be, and there is a body of corresponding bulk where no such body is usually found. The inference is strong, if sive, that this body in a strange place is the inverted uterus.

gnosis may be made clear or absolute (1) by passing a finger into , and then passing the fingers of the other hand above the pubes rds the sacral promontory; if the two hands are thus brought to bsence of the uterus from its proper place is established. (2) There test. The fingers, dipping into the pelvis, find their way into the med by the inverted uterus, and the round ligaments may even ut running into this hollow. Upward pressure of the procident

mass will bring these signs into greater relief. (3) Or there is still another test. The finger in the rectum reaching above the procident mass, a sound or catheter is passed into the bladder, and the concavity turned backwards; the point reaches over the procident mass, and is felt by the finger in the rectum.

If the placenta still remains attached, the mass will be correspondingly larger. It ought to be known whether the placenta have come away or not. The cord will afford a ready clew if it have not been torn off. In all cases of difficulty the doubtful body should be inspected by the eye if possible, as well as by the touch. The ramifications of the umbilical vessels over the surface of the mass and the torn membranes will reveal the placenta. A placenta in this position is presumably detached, and removable without further force. If it be found that it cannot be so removed, the reason of the resistance must be carefully sought. The membranes should be drawn forwards so as to bare the edge of the placenta; it will then be felt, and seen to be attached to a spherical body, which is almost certainly the uterus inverted. Not quite certainly, because cases are known where the placenta has grown to the child's head, or to a polypoid tumor projecting from the uterine cavity. This second case is one of real difficulty—the more so since the polypus may have caused inversion of the uterus. There will then be three masses in very unusual connections: placenta, tumor, inverted uterus.

Whilst we are making all this out, the patient may be dying of shock and hemorrhage. Still, however urgent the need of help, there is more danger in precipitate, unreasoned efforts than in the procrastination necessary to take an accurate survey of the situation, and to deliberate on the proper course of action. By taking time we shall probably do what is right.

The recently inverted uterus has a remarkable property which distinguishes it from every other tumor. Contractility is a property that no polypus possesses. If the tumor, then, hardens and relaxes alternately, we know it is the uterus.

The recently inverted uterus is also usually very much larger than a polypus. And the polypus traced up to its root or origin will lead to a cavity—the cavity of the uterus.

The case of incomplete inversion—that is, in the stages of depression or introsusception—may be very difficult to diagnose from polypus. There may in both cases be a tumor above or engaging in the cervix. The finger or sound will pass into the uterine cavity around the base or neck of the tumor. The diagnosis will depend upon being able to feel the inverted cup of the fundus through the abdominal wall, whilst a finger of the other hand is in the uterus. In the case of polypus, no such cup is felt, but the body and fundus of the uterus are felt in their usual relations and convex shape. Bimanual palpation and the sound determine these points.

Should the placenta have come away, the case, although so far simplified, is still not free from danger of mistake. There is a large, rounded, fleshy mass, bleeding, hanging between the thighs. It may be mistaken for placenta, for some part of a child, normal or abnormal, for a polypus or other tumor, or even for a mass of coagulated blood. If you have been following the uterus down during the extrusion of the placenta, or afterwards to insure contraction, and suddenly feel the uterus retreat into the pelvis, a firm mass appearing simultaneously in the vagina or externally, you have, with the symptoms of shock, strong presumptive evidence that the uterus has become inverted. You may make this sure by pushing the tumor back a little up the vagina with one hand while you press in the flaccid abdominal wall, with your other hand, behind the symphysis. The cup-shaped depression formed by the introcedent fundus uteri may thus be felt.

Course, Terminations, Prognosis.—1. The patient almost immediately or
on after the accident, dies from pure shock. The shock attending simple
pression has proved fatal.
2. More frequently death occurs rapidly from shock and hemorrhage com-
ed—that is, within twelve hours. 3. The inverted uterus may be strangled
its own cervix or by the vulva. This induces continuous or secondary
ck, and in some cases, if the patient survives long enough, and it need
be long, gangrene ensues. The uterus has sloughed off. Saxtorph, De-
rier, Radford, E. Clemensen give examples. R. Milne Murray[1] relates a
e in which the uterus was found inverted twenty-four hours after spon-
eous expulsion of placenta. It was replaced without difficulty, but was
ain found inverted on the following day. On the thirteenth day the ute-
sloughed off without hemorrhage. The patient recovered. In other
es the strangulation has ended fatally before there was time for sloughing
elpeau). Death has ensued from strangulation of intestine in the uterus.
rard de Beauvais relates a case.[2]
4. In some cases, and these not rare, the shock and hemorrhage are not
ry severe, or, at all events, the woman survives the immediate effects, ral-
s, and is thought to be safe. Tolerance, more or less complete, may ensue.
ut generally metrorrhagia continues, interrupted perhaps at intervals, but
ways liable to recur at the menstrual epochs. The losses thus induced
ay prove fatal at no distant date.

In the recent state, *retention of urine*, owing to the distortion and compres-
ion of the neck of the bladder and urethra, is not uncommon. This has
een relieved when the uterus was restored. But congestion of the mucous
embrane of the bladder, cystitis, even retrograde kidney trouble, may en-
ue, as in retroversion of the gravid uterus.

5. When the case is not fatal, and the uterus is not reduced, it merges
nto the chronic form. For the history of this form we must refer to the full
escription given in the "Clinical History of the Diseases of Women."

6. Meigs and others affirm that spontaneous reposition has occurred. This
s denied by Crosse. A case, however, related by Spiegelberg[3] seems clear.
Denham relates[4] a case in which spontaneous reduction completed reduction
hat could only be partially effected by the taxis. Some cases related are
pen to doubt. A polypus may have dropped and have been mistaken for
he uterus. But there seems no reason to question that inversion in the first
nd second degrees may be reduced spontaneously. We have only to sup-
pose that the lower segment of the uterus, contracting below the equator of
he introcedent globular mass, may cause this mass to spring back into its
place. We have, indeed, observed this ourselves in the first degree of
depression.

Treatment.—When we find inversion the indication is clear to reduce it,
nd that as soon as possible. If we can catch the happy moment whilst the
uterus is still flaccid, reduction is comparatively easy. Indeed, Lazzati and
most authors state that as complete inertia is necessary to the production of
inversion, so it is also necessary for reposition. The time at disposal is short.
The presence of the uterus, grasped in its own neck, excites contraction, the
part gets strangled, and it becomes more and more difficult to return it. It
was at one time considered a hopeless task to persevere in attempts at reduc-
tion unless it was accomplished within an hour.

The first question to determine is the fitness of the patient to endure the

[1] Edinb. Med. Journ., 1883.
[2] Arch. de l'Acad. de Méd., 1843.
[3] Arch. f. Gynäkologie, vol. v.
[4] Dubl. Quarterly Journ. of Med. Science, 1866.

operation. If prostration be marked, lose no time before injecting a drachm of ether under the skin. The catheter should be passed as a rule.

The *posture of the patient* is the left lateral, inclining to the prone. The pelvis is drawn near to the edge of the bed, the knees well flexed upon the abdomen. Anæsthesia by ether may be desirable, but not at the sacrifice of time.

The second question that arises is as to detaching the placenta first or not. To detach the placenta is to lose a little time, to risk flooding and irritating the uterus to contract; if we leave it, there is the greater bulk to pass through the cervical ring. If we have the good fortune to recognize the accident at the moment, we may be able to take advantage of the flaccidity of the cervix and return uterus and placenta at once. But if this favorable moment is lost, it will be better to detach the placenta first. This is done by finding the margin, insinuating one or two fingers between it and the uterine globe, supporting the uterus by the other hand, and peeling off the placenta by sweeping the fingers along. When the placenta is wholly detached, proceed to reduce the uterus. The mode of manipulation must vary according to circumstances. If the uterus is large, flabby, and the cervix dilated, it may be quickly replaced by depressing the fundus with the fingers gathered into a cone, and carrying the hand onwards through the os. Lazzati says it is better to apply the closed fist to the fundus; this acts better, and avoids the risk—by no means a slight one—of perforating the soft structure of the uterus. In executing this manœuvre two things must on no account be omitted; one is, to support the uterus by the other hand pressing firmly down upon it from above the symphysis, lest the vagina be lacerated. The vagina is very extensile after labor. It sometimes elongates under pushing so readily that we may fail to realize whether it is stretching or rending. The other thing to observe is the course of the pelvic axes and the form of the pelvic brim. This knowledge will guide the direction of pressure. Pressure at first should be made a little backwards towards the hollow of the sacrum; then the direction must be towards the brim, and at the same time *to one side, so as to avoid the sacral promontory.* As in attempts to reduce a retroverted gravid uterus, failure has often ensued from not understanding this. It was, we believe, first insisted upon by Dr. Skinner, of Liverpool. By attention to this rule we have reduced a uterus in fifteen minutes which had been inverted for ten days, defying repeated efforts by other surgeons. The side to select is the left; the patient lying on her left side, the uterus thus more easily slips past the promontory. When reduction has been accomplished, the hand, following the receding fundus, will occupy the cavity of the uterus, and the organ will be grasped between the hand inside and the hand supporting outside. Care should be taken to avert what has happened, namely, reinversion. To secure this, pass up along the palm of the hand a uterine tube connected with an injecting syringe; throw up a pint of hot water (110° F.), and if the uterus is felt to contract, the hand is withdrawn; if contraction do not follow, throw up a styptic solution, such as perchloride of iron. The effects of this are: constriction of the mouths of the vessels, arrest of hemorrhage, excitation of uterine contraction, corrugation of the tissues, and narrowing of the cervix uteri. When this state is induced we may look with confidence for safety. Dr. Spearing published a case in which reinversion occurred immediately after reduction. The woman died in fifteen minutes after reduction.

If uterine action be present, especially if the cervix is constringing the inverted part, contracting spasmodically, the difficulty is greater, and it is no longer judicious to commence by pushing in the fundus. McClintock showed that doing this is to double the inflexion of the uterine walls, and

thus to double the mass that has to pass through the os. He advised to regard the inversion as a hernia, and *to replace that part first which came down last.* The tumor must be grasped in its circumference near the constricting os; firmly compressing it towards the centre, and at the same time pushing it upwards, forwards, and *to one side.* The pressure must be steadily kept up, as the resistance of the os is overcome by sustained pressure. After a time the os is felt to relax, the part nearest is pushed through, and then, generally suddenly, the body and fundus spring into position.[1] This proceeding is best carried out under ether.

Dr. Noeggerath insists upon the advantage of indenting the fundus first at one or other of the angles where the tubes enter. This oblique indentation, he says, is far more effective than indenting in the middle of the fundus. There seems to be a sound physiological as well as clinical argument in favor of this proposition.

If the opportunity of reducing within a few hours be lost, the difficulty increases through advancing involution of the uterus, and especially contraction of the cervix. But still reduction is simply a question of time and skill. The principle of steadily sustained elastic pressure, advocated and practised by Tyler Smith, has given excellent results. For information upon this point we must refer to the "Clinical History of the Diseases of Women."

Reduction, however, does not always insure recovery. Many patients have died soon after reinversion. In some instances, perhaps, further injury has been inflicted during the operation. But it must not be forgotten that laceration of the vagina or uterus may have been spontaneously produced at the same time as the inversion.

In some critical cases, in which the uterus is partly torn from its connections, the question may arise whether it be not better to complete the removal of the organ by the knife or scissors, having first transfixed the root by needles and secured the opening by sutures. The proceeding seems desperate, but circumstances may justify it.

The *after treatment* will consist in absolute rest, opiate suppositories, or chloral enemata, containing one drachm of chloral, ice, and appropriate means to arrest vomiting.

In subsequent labors increased disposition to inversion may be anticipated. There are several cases in which inversion has happened in successive labors.

Retroversion and *retroflexion with prolapsus*, and *anteversion* and *anteflexion* may follow labor. These accidents have been referred to under "Hemorrhage."

Subinvolution has been referred to in the "History of Puerpery." The chronic state passes under the "Diseases of Women."

The *nervous disorders* have been described in connection with the neuroses of gestation, labor, and puerpery.

Disorders of the circulation and lungs are described as part of the "History of Puerpery."

Retention of the placenta has been studied in connection with the "Diseases of the Ovum" and "Abortion." It has also been referred to in connection with post-partum hemorrhage. It is still desirable to give a brief account of other relations of this complication. It has been elaborately described by Hegar,[2] Hüter,[3] Fromont,[4] and others.

[1] J. G. Wilson, Glasgow Med. Journal.
[2] Die Pathologie und Therapie der Placentaretention, 1862.
[3] "Die Mutterküchenreste," Monatsschr. f. Geburtskunde, 1857.
[4] Mèmoire sur la rétention du placenta, 1857.

It may be stated briefly that retention is due (1) to defective or irregular action of the uterus, or (2) to morbid adhesion. The first order of causes has been sufficiently considered in the section on the management of the placental stage of labor, and the second in the section on "Secondary Hemorrhage."

Stadtfelt[1] states as a cause that the placenta may be too loose in texture, so that the lobes are easily separated from one another, and one or more may be left behind. This applies especially to the small accessory lobes. He says, out of seventy autopsies he witnessed of women dying in puerperŷ, large remains of placenta were found in seven. David Davis and Ramsbotham believed that a frequent cause was inflammatory exudation between placenta and uterus. Wigand said it was due to scrofulous or arthritic condition of the body.

Another cause is the forcible extraction of the placenta. Even when there is no morbid adhesion, such disorder in the action of the uterus is induced that the placenta may be torn, and pieces remain behind.

The placenta may be retained entire or in part. It may be expelled or removed several months after labor, no other consequences resulting beyond hemorrhages and arrested involution.

Caseaux points out that in such cases the freshness of the placenta is accounted for by the integrity of its vascular connections with the uterus. Hemorrhage is the most constant attendant. But where the relation with the uterus is entirely or in great part lost, the placenta is liable to undergo putrefactive change. This may or may not be attended by septicæmic fever or inflammation. In the case of putrefaction, *physometra* or *tympanites uteri* is likely to result. The cervix uteri being excluded, either by a mass of blood or the placental mass lodging over the os internum, gaseous accumulation takes place, distending the uterine cavity to the extent of notable enlargement. It thus rises considerably above the symphysis pubis. Commonly great pain and tenderness on pressure are felt; some irritative fever, with rise of temperature and pulse, with a sallow aspect, indicate toxæmia.

One consequence of retention of a bit of placenta is that it may form the nucleus upon which layers of blood may aggregate, forming the *placental and fibrinous polypus*.

Treatment.—Two conditions attend all the forms of the retention—namely, hemorrhage and excessive bulk of the uterus. Now, as a general rule, hardly admitting of exception, whenever these conditions exist, the cervix should be dilated, and the cavity of the uterus explored, under anæsthesia if necessary. The noxious substances can then be cleared out. This done, irrigation with carbolic acid solution, 1 in 50, or with bichloride of mercury, 1 in 3000, should be used for some days. Quinine, ergot, and digitalis will also be useful.

Nonat[2] described *fongosités intrautérines* as placental remains. Small polypoid excrescences keep up hyperplasia and hemorrhages. We have seen many examples. Some were malignant, and could not be traced back to labor. Here, again, the treatment indicated is to dilate the cervix to get good access to the cavity of the uterus, and to deal with the excrescences by scraping or application of iodine or nitric acid. If of placental origin a cure may be anticipated. Scraping must be practised with gentleness and caution, lest the instrument penetrate the substance of the uterus.

In like manner, *shreds of membrane may be retained*. Like the placenta, the membranes may contract morbid adhesions. Similar consequences attend, and similar treatment is indicated.

[1] Dublin Quart. Journ. of Med., 1863.
[2] Traité pratique des Maladies de l'utérus, 1860.

CHAPTER XXI.

ON SUDDEN AND QUICK DEATH IN GESTATION, LABOR, AND PUERPERY: THROMBOSIS, EMBOLISM, APOPLEXY, SHOCK, AIR IN VEINS—INJURY OF SPLEEN, ILEUS, AND REMANENT LESIONS AND DISEASES FROM GESTATION AND LABOR.

DEATH may happen quickly—that is, after very brief warning of danger, or even suddenly, without warning. This event may occur during gestation, labor, or puerpery.

It is of importance to study this subject apart from the systematic description of the diseases and accidents, some of which issue in death more or less sudden. When death occurs suddenly, the first impulse of the friends or assistants is not seldom to suspect that the doctor is to blame. No doubt this suspicion may sometimes be justified. But far more frequently it will be found that the catastrophe was beyond his immediate control. We use the qualification "immediate," because in some cases the catastrophe might have been averted had the opportunity been afforded of applying proper treatment during the initiative conditions. But in many instances no opportunity for prophylaxis has been afforded. And in some cases, even where the physician has the opportunity of antecedent observation, the course of the lethal events may defy his skill.

Classification of the Causes of Sudden Death.

The causes may be most usefully analyzed into—(1) Those which occur during gestation; (2) those which occur during labor; and (3) those during puerpery. Similar causes may lead to death in each of these three epochs; but in each epoch there are causes more especially operative.

1. CAUSES OF SUDDEN DEATH DURING GESTATION.—It may seem paradoxical to state that death, sudden or slow, may occur, apart from violence, in a healthy subject. Still, if it be granted that some morbid condition must be in existence, it is nevertheless true that it cannot always be detected, even after death. Reference to the chapter on the "Diseases of Gestation" will show that the normal conditions evoked are sometimes so exaggerated as to overstep the narrow boundary between physiology and pathology. Without serious organic change, the functional energies may be so exalted that the organs cannot bear the unwonted strain. In this sense the heart, for example, although substantially sound, may be overpowered—paralyzed.

But in other cases there is decided structural disease, as of the nervous centres, lungs, or circulating system, preëxistent, or developed during gestation. In such cases the intensified functional strain will naturally tell more severely.

As in the non-pregnant, sudden death is immediately caused by oppression of one of the great vital centres, the brain and medulla oblongata, the lungs, and the heart. The first blow may strike any one of these centres; but the others are quickly involved, and it is not always easy to discover which was the first to suffer.

We believe that it is more in accordance with clinical observation to begin with the heart. Indeed, sudden death is most frequently associated with

changes in the vascular system. Under violent emotion fatal syncope may occur, the ordinary physiological hypertrophy of the organ being the only condition detected. De Cristoforis relates a case which occurred in the wards of Professor Esterle.[1] A woman took an excessive meal, and under the commotion of vomiting died in a few moments. She had the normal hypertrophy of the left ventricle; the texture of the myocardium was intact. There was œdema of the lungs and disturbance of the circulation dating from the seventh month. Cæsarean section was performed post-mortem.

In other cases, marked fatty degeneration of the myocardium has been observed. In two cases, in which death occurred suddenly towards the end of gestation, Robert Barnes detected this change. In one, the immediate cause was excessive exertion.

Death has occurred suddenly under severe straining at stool. Thus, Robert Barnes assisted at the autopsy of a young primigravida at the Clinique d'Accouchements at Paris. She was near term. She died as if struck by lightning when at stool. There was found a hydatid in the wall of the aorta just above the valves, which had caused thinning of the wall, so that when it burst, rapid effusion of blood took place into the pericardium.

Under the extreme vascular tension of gestation, blood-extravasations are not uncommon. As we have seen in the history of abortion, the vascular tension most commonly finds relief by effusions from mucous membranes, and notably from the uterus. But occasionally bloodvessels in the lungs or brain give way. In the case of lung-apoplexy, recovery may ensue, but sometimes rapid death occurs. When the extravasation takes place in the brain, the issue is generally fatal. The usual symptoms of apoplexy set in: coma, stertor, and convulsion; and commonly abortion attends, produced by the accumulation of carbonic acid in the blood. In such cases the death is much less rapid than when the blow falls first upon the heart.

Grenser[2] relates the case of a woman who, near term, complained of faintness and headache, then vomiting. Soon after this she became soporous, the pupils contracted, the pulse quick. In a few hours complete unconsciousness set in; the face became cyanotic; contractions, especially of the muscles of the neck, appeared; death followed in twenty-four hours. The child was extracted by Cæsarean section. A thick purulent layer was found on the dura mater and arachnoid. There was also hyperæmia of the brain and œdema of the lungs. How far the suppurative inflammation of the membranes of the brain was dependent upon gestation must be a matter of speculation.

We have known rapid, almost sudden, death ensue upon œdema of the lungs, and more especially when there was ordinary pneumonia or phthisis. In cases of lung-inadequacy, comparatively slight events that suddenly disturb the equilibrium of the circulation may prove quickly fatal. This mode of death is likely to happen in connection with albuminuria.

Thrombosis in pregnant women is rare, but several well-observed cases have been published. One was related by Edward Smith, a skilled and keen physiologist. A woman, æt. 20, near term in her second gestation, after a hearty dinner, having exhibited excellent spirits, "suddenly uttered a shriek, flung her arms about wildly, and cried, "Oh! my head; I cannot breathe; I am going mad! Give me my breath!" This continued for five minutes, during which time her hand was placed upon her chest. She became calm for a moment, and said to her husband, "There, Charles, I am

[1] Annali Universali di Medicina, 1867.
[2] Monatsschr. für Geburtskunde, 1865.

er," and expired. The face was livid, and the body bent so that the es approached her chin. Autopsy forty hours after death: The blood black and fluid universally, except in the pulmonary veins, where the le tube was filled by a cylinder of coagulum, having a central clot of d enclosed by two layers of condensed fibrine, the outer one of which colorless, and the whole so firm that it could be handled with impunity. number of white corpuscles was much above the normal standard. The ie of the heart, more particularly on the right side, was undergoing the stage of fatty degeneration.

Dr. Philipson relates an analogous case ("Lancet," 1865). A woman, 35, in her first pregnancy, had been suffering from a slight bronchitis. the act of answering the street door, she fell to the ground, and was dead a few minutes. Autopsy: Dark blood flowed quickly on incision. The t auricle was full of black blood of the consistence of soft jelly. The d in the venæ cavæ was very dark and fluid. In the right ventricle a fibrinous mass, which extended through the pulmonary artery, and right and left divisions, as far as they could be traced in the lungs. The cretion in the ventricle was very firm, spirally laminated, firmly adherent. fatal case of embolism recently occurred in St. George's Hospital. The ject, about eight months pregnant, died suddenly. An embolon from a icose vein in the leg had lodged in the pulmonary artery.

Sudden death during labor is more common than during gestation. The ie conditions that lead to death during gestation may exist when the man is overtaken by labor; and the enormous strain of labor will then with redoubled force. We need not do more than note the rapid deaths t ensue from uterine hemorrhage, external and internal, or from rupture the uterus. In these cases the fatal issue, although often rapid, is rarely te sudden.

A very striking cause of death is *shock:* a combination of mental, emoal, and diastaltic force, under which the heart may be paralyzed. ring labor the contraction of the uterus, the closure of the glottis, the ng of the chest-walls, combine to throw increased pressure upon the heart l brain. Sometimes, as Marshall Hall and Tyler Smith insisted, acute n extorts a cry, the glottis is opened, the strain is taken off, and rupture the uterus, extravasation in the brain or in the lung, or paralysis of the rt is thus averted. But, if not saved in this way, the patient is in minent danger, especially if there is an unsound link in the physiological in. Thus, the heart readily fails if it be degraded in texture or work, f the blood be poor.

Pain alone, perhaps, may kill. The shock attending pain may suddenly alyze the heart.

Allied to shock is *syncope*, which has proved fatal.

The more severe injuries, as inversion or rupture of the uterus, may kill e or less suddenly.

The lungs may be damaged under the strain of labor. We have seen re emphysema ensue, ending fatally.

Cerebral apoplexy has in several instances occurred during labor. Robert nes related an instance to the Obstetrical Society. The woman, about y years old, was in her seventh labor. Convulsion, stertor, and syncope n before the expulsion of the child. The child was expelled alive. The her died twenty minutes afterwards. A small clot, quite recent, was nd in the left thalamus opticus; and another, larger and of a dissecting racter, in the left crus cerebri.

If there is preëxisting mitral disease, sudden death is the more probable.

Fritsch[1] says this is due to the paralyzing effect of the sudden flow of a strong stream of blood into the right heart, caused by increased vascular tension. Panum showed that a sudden jet of blood propelled into the right heart does paralyze it.

Entry of Air into the Veins and Heart.—Sudden death may result from this accident. After labor, the uterus being relaxed, and the patient inclining forwards, under the combined influence of bagging forward of the uterus, the want of contraction of the abdominal walls, and atmospheric pressure, air may be drawn into the uterus, and thence sucked in by the open mouths of the veins. Carried to the right ventricle, the circulation and action of the heart are so disturbed that rapid death may ensue. It is, however, certain that the entry of a moderate volume of air is not necessarily fatal. Another way in which air gets into the veins is when foul air is generated in the uterine cavity as the product of decomposition.

We cite a case from Olshausen[2] as a good clinical illustration. A 2-para of robust frame, æt. 29, was at term. The uterus was unusually distended. No albuminuria. Labor being lingering, the uterine douche was used, the water being at 30° R.; it was forced into the vagina gently. After eight minutes' use the woman complained of oppression; the tube was withdrawn. The woman rose in bed, immediately fell back senseless, and died in a minute, at most, under convulsive respiratory movements, and distortions of the face. Eight minutes later, bleeding from the median vein was tried, but only a few drops flowed. On touching the body, distinct and widely spread crepitation was felt. Autopsy eight hours after death: A large quantity of dark fluid blood escaped from the sinuses of the dura mater. The cerebral membranes were very hyperæmic; the lungs somewhat congested. The heart was lying transversely; the left ventricle was in firm contraction; the right quite soft, something like an intestine with thick walls; the coronary vessels contained a quantity of air-bubbles; the left heart contained scarcely any blood; the right held a little, it was frothy. The distended uterus crepitated everywhere under the hand. A number of vessels of medium calibre, immediately under the peritoneum, were plainly filled with air. The right broad ligament was strongly distended with air-bubbles, and this emphysema of cellular tissue extended from the broad ligament through the retro-peritoneal space to the inner side of the right kidney, and even below the liver to the vena cava ascendens. This vessel was enormously distended by air. The uterus being divided in the median line, a placenta was found attached to the anterior wall, a small flap being detached from the uterus; another placenta was attached behind and to the right; a larger portion of this had been separated. The two ova were uninjured. Death, then, was caused by forcing air into the placental site.

N. Heckford published[3] a case. A woman, æt. 43, died suddenly in childbirth—her eighteenth labor. Labor commenced at 4 P. M.; a female friend, who alone was attending, said that after a few strong pains a living child was expelled, and the woman died immediately afterwards. There was no hemorrhage, and the placenta had not been interfered with. The heart and bloodvessels were healthy. Both ventricles contained frothy blood. On making sections of the different viscera, air bubbled freely from the divided vessels; this was very conspicuous in the arteries of the brain. The case occurred in winter, and there was no decomposition. The greater part of the placenta was still attached, but at one spot it was detached. Air must have entered by the uterine sinuses.

[1] Arch. f. Gynäkologie.
[2] Monatsschr. f. Geburtsk., 1864.
[3] Med. Times and Gaz., 1867.

Dr. More Madden relates[1] a case of death from this cause.

Hervieux relates a case in which furious mania and death followed in thirty hours after an intrauterine injection to correct offensive lochia. The air was collected and analyzed. It consisted of oxygen, 7; carbonic acid, 11; and nitrogen, 82. That is, it was composed of the same elements as atmospheric air, but carbonic acid had replaced a part of the oxygen. In the same memoir[2] Hervieux traces the history of this complication.

Hall Davis related[3] the following case. In extremely hot weather he was called to a case of retained placenta, adherent. The subject was a multipara, æt. 40, of full habit and congested features. There was no loss of blood; the labor, although protracted, ended in birth of a live child, without instruments. Davis had just got his hand into the uterus to commence detachment of placenta, when the patient was suddenly seized with convulsions and died. No autopsy.

Similar cases are not extremely rare. Can they be explained on the theory of shock causing syncope, or by the entry of air into the veins?

Death may occur suddenly from hemorrhage into the peritoneal cavity. More Madden cites a case of rupture of a varicocele of the left ovarian vein proving rapidly fatal. Jacobi[4] showed a preparation to the Berlin Obstetrical Society from a woman who had died suddenly after a normal labor. Under the peritoneal covering of the uterus was an extravasation of blood near the two very varicose uterine plexuses.

Tetanus may cause sudden or rapid death. The subject has been referred to in the "History of the Diseases of Gestation." In addition to the authorities there cited, Dr. Gordon[5] gives instructive facts. In three cases tetanus came on during abortion. He cites a fourth from Dr. Storer. After labor at the seventh month, an attempt made to detach adherent placenta provoked tetanus, which terminated fatally the next day.

Sudden death in puerpery is far more common than during gestation or labor. Some of the predisposing causes are continued from gestation, and new ones are superadded. Thus, the woman who has gone through the perils of gestation and labor not wholly unscathed, is more likely to sink under the fresh trials of puerpery. Of these, the most frequent, perhaps, is thrombosis, attended or not by embolism. The history of this affection, so full of interest, will be traced in a succeeding chapter.

Death may occur suddenly at various periods down to three and four weeks after labor. In some cases the catastrophe falls with startling suddenness. A woman has gone through labor and two or three weeks of puerpery in the happiest manner, when, without a moment's warning, in the midst of cheerful conversation, on some slight effort she is seized with sudden sense of oppression, gasps for breath, cries for air, feels faint, and falls back dead. In some cases of this kind autopsy has revealed no adequate explanation. In such cases we are driven to the hypothesis of syncope. In other cases dissection has revealed embolism or thrombosis in the pulmonary artery.

Spiegelberg relates a case of sudden death on the third day from rupture of the left ventricle; there was myocarditis.

Sir J. Y. Simpson relates three cases of sudden death in which the spleen was found ruptured. In one the subject sank shortly after labor at the sixth or seventh month. There was found laceration of the enlarged spleen, and blood in the peritoneal cavity. In a second case, a woman, after making unusual exertion, a week or two after labor, complained of abdominal pain,

[1] Dublin Quarterly Journ. of Med., 1871.
[2] L'Union Médicale, 1864.
[3] Obstetrical Transactions, vol. xi.
[4] Monatsschr. f. Geburtsk., 1866.
[5] Amer. Journ. of Med. Sc., 1866.

sinking, and died. There was rupture of the spleen. Dr. Cunningham delivered a woman by forceps. She died in an hour or two. The spleen was found ruptured.

Shock may not kill at the time of labor, but the blow may be so severe that the system is left shattered. Slight depressing causes will then act with fatal force. The mental agony that waits upon illegitimate maternity is sometimes enough to extinguish life. Of this we have known several sad examples. We have seen a woman die the day after labor from sheer grief and shame. Under the term "*Collapsus post partum*," Baart de la Faille has collected[1] thirteen cases of sudden death, four of them quoted from Ramsbotham.

Many examples of sudden death from thrombosis and embolia are scattered through the medical journals, and in various other publications. O. Van Franqué relates[2] three cases. In one, death occurred suddenly on the fourth day after labor, preceded by difficulty of breathing for three minutes. Fibrinous vegetations were found on the mitral valves; a complete adhering clot in the right pulmonary artery. In the second case there had been hemorrhage during labor and artificial detachment of the placenta, syncope, anæmia: on the ninth day pain occurred in the right leg in the course of the veins; this pain subsided, and on the sixteenth day dyspnœa, præcordial pain, and death occurred. There was œdema of the lungs and a complete thrombus in the pulmonary artery. The veins of the right leg were filled with clots. In the third case there had been disease of the veins of the left popliteal space during pregnancy. In the third week after labor sudden dyspnœa was followed by death in an hour. There was œdema of the lungs; the right pulmonary artery was filled with a thrombus; and there was thrombus in the veins of the left popliteal space. Van Franqué concludes that acute œdema of the lungs is the cause of sudden death.

Hervieux[3] relates several cases. We cite one as a useful illustration. A 2-para, æt. 40, admitted into the Maternité, had repeated shivering, œdema of the legs, and died suddenly. There were metritis, abscess of the broad ligaments, metastatic abscess of the spleen, hypertrophy of the liver, granular infiltration of the kidneys, pleurisy, œdema of the lungs. Another patient, æt. 44, died from meningeal hemorrhage.

Death may occur suddenly from entry of air into the veins in the puerpera. We found a large quantity of air in the heart and vena portæ of a young woman who died after convulsions from albuminuria.

Hervieux says that sudden death may ensue upon the first shock or other influence caused by the entrance of septic poison into the circulation. We believe we have seen cases that might be explained on this hypothesis, although it may be suspected that the poison acts by causing thrombosis.

Ileus.—We have known sudden or rapid death to occur from intestinal obstruction. In one case all the symptoms of intestinal obstruction arose, but after death we failed to trace the seat of obstruction. We could only conjecture that there had been pressure upon the large intestine by the uterus, and a local paralysis. In other cases a constriction has been caused by a band of inflammatory effusion. Where vomiting, especially stercoraceous, rapid distention, constipation, and collapse threaten, the question of opening the abdomen to search for the seat of obstruction must be considered.

Amongst the accidents that follow upon labor we have to note *spontaneous inflammation of varicose veins of the legs.* M. Nivert,[4] in a memoir under this

[1] Monatsschr. für Geburtsk., 1865.
[2] Wiener Med. Halle, 1864, and Monatsschr. f. Geburtsk., 1865.
[3] Gazette des Hôpitaux, 1865. [4] Archives gén de Méd., 1862.

, says suppurative phlebitis may become encysted, and so the pus may enter the circulation; on the other hand, free suppuration may lead to ulent infection. These cases are intimately associated with phlegmasia ns and septicæmia, and only call for commemorative mention in this e.

nother accident, also allied to poisoning, is the so-called *putrescentia* . It has been carefully described by Böer, Wengel, Jörg, Carus, Romg, Schönlein, Von Siebold, Rokitansky, Virchow, Klob, and others. b's views may be taken[1] as summarizing the opinions of other observers. describes it as the "highest degree of endometritis. The walls are genly imperfectly contracted, thin, often showing red discoloration on the toneal aspect. The uterus rises high in the abdomen, and is generally ied to one side. The mucous membrane is brown, dark, shreddy, stinking. section the submucous tissue is often found changed to an ash-colored gh. The placental seat is generally the seat of a deep suppuration; the mbi have mostly fallen; the ends of the veins are in shreddy necrosis; veen them and in them is a chocolate-brown sanious fluid, purulent ses, or thick pus. Frequently the necrosis spreads deeply into the proper ine substance, so that the inner surface shows deep excavations, and the cular tissue is necrosed. The destruction may extend in places to the toneum, which may even be perforated."

okitansky and Virchow called some cases of this kind "Erysipelas ignum puerperale internum." They mostly occur in hospitals, and our observation leads us to look upon them as analogous to hospital gane.

charlau[2] relates a case in which a perforation of the uterus attending kind of necrosis opened into a perforation of the intestine. It resulted a very protracted labor terminated by cephalotryptor. There were ration of the vagina, starting of the sacro-iliac joints, pus on the articung surfaces, denudation of the pubic bone opposite the rent of the ina. Thus it appears that necrosis of the uterus may be caused by the shing of violent labor, and the attendant alteration of blood and nervous austion.

Strangulation of an umbilical hernia may follow labor, as in a case recorded[3] Mr. Bracey. Recovery followed operation.

Remanent Lesions and Diseases from Gestation and Labor.

The history given of the physiological and pathological processes of station and Labor includes much of what, in strict sequence, would be cribed in this place. It will be sufficient here to give a systematic enumtion of the remanent lesions and diseases, filling up the gaps and imper descriptions of preceding chapters, and stating some guiding and conting general propositions.

Amongst *general propositions* the following may be stated: 1. Every tissue every organ has been tested under high pressure—that is, both as to integrity of their elementary components, as to their perfection of conuction, and as to their working capacity.

Few women go through the trial altogether scathless. Traces of the mage sustained in the struggle will commonly be found in some organ or ue. These may be classified as follows:

A. Some of the physiological exaggerations of organs and tissues described

[1] Patholog. Anatomie der weiblichen Sexual-organe, 1864.
[2] Monatsschr. f. Geburtskunde, 1866. [3] British Med. Journ., 1882.

as arising during gestation remain. Some of these will be intensified by labor and puerpery, and labor and puerpery may add new disorders.

B. Some pathological diatheses or organic lesions, latent until gestation supervened, and evoked by that process, persist in evidence. These also may be further intensified by labor and puerpery, and new lesions and diseases may be evoked.

C. Traumatic lesions.

A. Physiological Exaggerations.

In the *vascular system* we find, anæmia; hypertrophy of the heart; goitre, exophthalmos; venectases, in the form of piles, or of varicosities on the legs and vulva. It is probable also that venous dilatations might be found in the abdominal and thoracic cavities and organs if they were systematically searched for.

The *liver and kidneys* may not recover entirely from the granular change started during gestation.

Paralysis of the bladder may be transitory, lasting not more than twenty-four hours, or persisting for days or weeks. We have known it to last for several years. It is mostly the result of the shock, the exhaustion of labor. The nervous energy has been used up, and until a fresh store has been produced, the bladder, like the uterus and intestines, is without the due supply. It is not uncommon to find that from this cause, for a day or two the bladder refuses to act. The obstetrist should always have a catheter in his pocket, and not wait too long before using it, for should the bladder not empty itself, the accumulation distending the bladder tends still further to paralyze it. Sometimes the bladder will act with the bowels. But if there is still on the second or third day retention, or dribbling, which means retention (as explained under "Retroversion of the Gravid Uterus"), we must seek the cause or associated conditions. These may be retroflexion of the large uterus, distention of the uterus by a clot, loading of the rectum, fever; or the retention may be apparent only, the real condition being non-secretion.

Grenser describes[1] twenty-five cases caused by swelling of the neck of the bladder. One case lasted fourteen, another seventeen, days. The loss of power is rarely permanent. Rest, and keeping the bladder relieved by catheter, will commonly bring recovery in a few days. If it persist, examination should be made to ascertain if the uterus is in due position. We have known retroflexion of the enlarged uterus after labor keep up retention of urine. To hasten recovery, Faradization is very effective.

Whenever there is any doubt, pass the catheter. This, if even superfluous as treatment, is of diagnostic value.

Sometimes allied to paralysis of the bladder is *cystitis*. Chronic cystitis occasionally follows labor, and this origin should be considered when studying the affection. Dr. C. Monod has written an excellent monograph (1880) on the subject. His conclusions are: that it may arise from pressure of the gravid uterus, and from the hyperæmia which the bladder shares from proximity to the uterus; that there is an acute cystitis belonging to the beginning of gestation; that there is a form of cystitis beginning after labor, properly called post-puerperal.

In like manner there may be tempory *paralysis of the bowels*. Their function being less urgent than that of the bladder, the disorder is not forced

[1] Monatsschr. f. Geburtsk., 1865.

upon our attention. The bowels ought to be emptied by an aperient, if required, before labor; and commonly the rectum at least is emptied during the expulsion of the child. Then it lies quiescent, perhaps for several days, unless made to act by an aperient or enema. If there is evidence of accumulation of feces, a warm soap and water enema should be given, as well as an aperient. If the bowels fail to act on the second day, an aperient should, as a rule, be administered. The action of the bowels provokes the uterus and bladder, and thus the three pelvic organs being unloaded, the course of childbed is made smoother. During the first action of the bowels a clot is frequently cast from the uterus.

We have seen death from ileus after labor as well as after ovariotomy.

The stomach and the digestive apparatus commonly partake of the general debility or lassitude. This condition has to be considered in regulating the diet. The old fashion was to keep the lying-in woman on gruel and other thin slops for a week or more. There was reason in this; but the practice was carried beyond reason. Oldham was, I believe, the first to break down this routine. He recommended substantial feeding the day after labor. We can hardly begin too soon to supply the system with good material for nutrition. But still we must be governed by the tolerance of the stomach and the digestive capacity. For twenty-four hours, at least, the stomach will hardly bear solid food. It will either be rejected or provoke colic. We have seen serious mischief caused by over-early and over-much feeding.

We must remember that active absorption has hardly set in under forty-eight hours. There is a stage following labor in which the whole system is at rest, or craves rest. The great argument for early free feeding is, that if good food is not supplied the system feeds upon itself—that is, it is apt to take up noxious matter, to poison itself. The argument is well founded. Still we may defeat our object by free feeding before the system can turn the food to account.

Nervous Affections Attending or Following upon Parturition.—The description of the Neuroses of Gestation should be referred to as an introduction to the present summary.

Amongst the neuroses attending upon parturition is a group of paralyses. In this place we do not think it necessary to describe cases of cerebral apoplexy. The subject has been incidentally treated in the section on sudden death.

Paralyses of the Special Senses.—We have already seen that deafness and amaurosis may follow an albuminuria during gestation. But a case narrated by Toynbee seems to show that deafness may result from the shock of labor. He relates the case of a lady who consulted him for complete deafness of both ears. She had become more and more deaf after each succeeding labor. Thus she had never heard the voices of her younger children.

Paraplegia has followed labor—examples are given in an earlier chapter. In most cases gradual recovery takes place. We have known the affection to be confined to one leg. In some cases it appears to be due to shock telling upon the spinal cord. We may suppose that the diastaltic function was excessively worked so as to exhaust the nervous centre. In one case, narrated by Robert Barnes,[1] paraplegia followed epilepsy during gestation. The gestation ended prematurely, so the paralysis could hardly have been due to pressure. In some cases paralysis of one leg has been caused by the crushing of the crural plexus by the forceps or even by the simple pressure of the head in labor.

Brown-Séquard described paraplegia as arising from retroflexion of the uterus.

[1] Lumleian Lectures.

In some cases lameness is not due to paralysis, but to relaxation or stretching of the pubic and sacro-iliac joints.

Hughlings Jackson[1] reports a case in which hemiplegia of the right side and loss of speech followed flooding. There was no valvular disease.

Dr. Ball describes puerperal paraplegia very fully. He says it is more frequent after parturition, but that it sometimes occurs during gestation.

The puerperal state has an unfavorable influence upon the functions of the spinal cord: 1st, weakness which pregnant women so often feel in the legs; 2d, aggravation of the paralytic symptoms in women who become pregnant after being paralyzed. This we have seen is not constant.

When it supervenes in the puerperal state it is generally in primiparæ; but exceptionally it occurs for the first time in pluriparæ. When it has once occurred it is liable to recur. The development of the disease is generally slow, insidious; the patients feel weak in the knees, and feel a tingling sensation in the tips of the toes. By degrees these symptoms increase, and paralysis sets in. Only one limb is paralyzed at first; at length both become paralyzed, and in several cases the bladder and rectum are affected.

In some cases the invasion is sudden, and the progress very rapid. Paralysis of both limbs may be complete in one or two days, and in severe cases the upper limbs become paralyzed, the respiratory function is affected, and death rapidly follows. At post-mortem examinations, signs of acute meningo-myelitis, with abundant suppuration, have been frequently found; in other cases extensive hemorrhage of the spinal cord has taken place. In one case the spinal cord was softened in the greater part of its extent. The sequelæ of puerperal paraplegia are not, however, so formidable in the great majority of cases; most recover in a few weeks or months, others remain crippled for life. In these latter cases there evidently exists an organic lesion. In the former the paraplegia must be attributed to reflex action.

The *neurotic remanents*, as deafness, amaurosis, aphonia, forms of paralysis or nervous exhaustion, have been studied in their connection with albuminuria in gestation: as also insanity. These disorders are also especially apt to follow severe hemorrhage.

The *uterus* is also liable to paralysis after labor. The condition known as inertia, so frequently associated with hemorrhage, is a form of paralysis. It is mostly temporary. But a minor degree, which might be described as defective tone, may persist for an indefinite time. It is, we believe, one of the factors of subinvolution. It is certain that when active contraction of the uterus sets in and is sustained after labor, there is little risk of defective involution.

We have seen several striking examples of enduring paralysis of the uterus. The organ remained large, even in cases where it was not retroflected; the subjects were liable to menorrhagia, resisting all ordinary treatment, general and local. It was associated with paralysis of the bladder, so that in one case the catheter has been resorted to habitually for several years. In this case aphonia also complicates; and there is general defect of muscular power. In another case the bladder refuses to act at the menstrual epochs. In this latter case, improvement is progressing under the topical application of Faradism.

To obviate this condition is one of the reasons why we systematically prescribe quinia, ergot, sometimes adding strychnia, after every labor.

In some cases, whether it be from paralysis of the ovaries or otherwise, amenorrhœa and sterility follow the labor. A condition associated with this was described by J. Y. Simpson as *hyperinvolution*, as if the process of in-

[1] London Hosp. Rep., vol. i.

volution did not stop short at the point of elimination of the structures developed for the needs of gestation and parturition, but, passing the normal line, went on into atrophy.

PIGMENTATION arising during gestation mostly leaves some traces behind. The nipples, the lower abdomen, and the external genitals generally, if not always, retain in some degree the darker color acquired. We have had under our care at St. George's Hospital a remarkable case of a young woman who, after being delivered of a syphilitic child, had pelvic cellulitis. Gradually dark-bronzing was diffused generally over the skin, more especially marked on the breasts, abdomen, external genitals, attended by peculiar languor approaching to hebetude. The condition forcibly suggested advancing Addison's Disease. When put under iodide of potassium, a marked paling of the skin and general improvement quickly took place.

This case strengthens the argument already stated in favor of subjecting the suprarenal glands to careful examination on every opportunity in women dying in gestation and puerpery.

B. Pathological Diathesis and Organic Lesions, Evoked or Intensified.

It is not always possible to draw the line between the cases which apparently fall under this head from those which more obviously fall under the head of physiological exaggerations. They dovetail or overlap.

Foremost amongst the diatheses evoked are the strumous, tubercular, and neurotic. *Struma* is revealed in mastitis, pelvic inflammations, protracted discharges.

Tuberculosis is revealed by similar conditions, and further by the aggravation of lung mischief.

The *neuroses*—insanity, chorea, epilepsy, ague—have been discussed in the "History of Diseases of Gestation."

The Heart.—Where heart disease, especially hypertrophy, previously existed, it is almost certain to be aggravated by gestation and labor. Associated conditions, as exophthalmos and goître, become intensified.

The Liver and Kidneys.—The same may be predicated of these organs.

The Lungs.—The relations of phthisis have been discussed in the "History of Diseases of Gestation." *Bronchiectasis*, if previously existing, becomes aggravated. But it may be produced, or the foundation for it laid, during the violent straining of labor. This is more likely if ergot have been given. Emphysema is sometimes associated in this way with bronchiectasis. We have seen striking instances of this produced by ergotic labor. Some of the overdistended air-vesicles give way; air spreads rapidly in the connective tissue, extending from the lungs to the neck and even to the chest.

C. Traumatic Injuries.

The Skin.—Under the rapid stretching of the skin of the abdomen during gestation, the tissues, unable to keep pace by growth, give way. The "*striæ gravidarum*" result. These have been described in the "History of Gestation."

We may here repeat the conclusions there set forth: (1) that the presence of striæ is a frequent remanent of gestation; (2) that their presence is not absolute proof of present or past gestation; (3) that their absence is not proof of nulliparity.

Striæ are sometimes formed on the breasts.

Separation of the recti abdominis muscles sometimes takes place during gestation and labor. This may occur at the umbilicus, or along the linea alba. In either case this separation may give rise to hernia, made evident under straining or expulsive efforts. This condition is sometimes called "Eventration." When it exists, it must be counteracted by a well-devised belt.

Pendulous Belly.—With or without separation of the recti muscles, the abdominal walls may become so relaxed after one or several labors as to lose all tone and power of supporting the intestines. The belly hangs down over the pubes; and in the event of another pregnancy the growing uterus, ill-supported, bags over, and there results a form of dystocia, which will be described under that head. To obviate this it is extremely desirable to supplement the defective functions of the abdominal walls by wearing a firm binder. Under the influence of this aid, the muscles and other constituents regain some of their lost power.

The Uterus and Perimetric Structures.—Fissures of the neck not healing may entail subinvolution, endometritis, ulceration, menorrhagia, perimetritis, sterility (Whitehead, Emmet), and even paralysis of the organ.

The vagina remaining relaxed, there ensue prolapsus in the form of rectocele, cystocele, uterine displacements. If there have been sloughing, fistulæ and cicatricial contractions result.

The perineum may also lose its firmness from overdistention or laceration. This weakness may indirectly favor prolapse of the uterus, since the floor of the pelvis is impaired. The vulva also unduly stretched, and the sphincter injured, the retentive power of the lower part of the abdominal cavity is weakened.

Occasionally *sloughing* or *gangrene* of the vulva follows labor. We have observed it after scarlatina and diphtheria. Chavanne[1] described an epidemic of this affection. Humbert[2] describes a similar epidemic at the Charité in Paris. Dubois, Otto, relate similar instances. All these occurred in hospitals. They may be compared to hospital gangrene in surgical cases. Some are due to erysipelas. Dr. Herman[3] has collected valuable records bearing upon this subject.

Evidences of Past Gestation, of Nulliparity, and of Virginity.

It is convenient to consider first the evidences of past gestation, since these consist of positive signs, whilst the evidences of nulliparity and virginity mostly consist in the negation of the positive signs of gestation.

EVIDENCES FOUND IN THE LIVING.—1. Of completed gestation and labor at term. 2. Of incompleted gestation, of abortion or premature labor, recent and remote.

A. In the Living. Recent and remote.

Some of the conditions enumerated in the preceding section, "Remanent Lesions and Diseases."

1. IN THE RECENTLY DELIVERED AT TERM.—We find in the *breasts* fulness, perhaps hardness, secretion of milk, darkened areola, prominence of tubercles.

In the *abdomen* the skin and abdominal walls lax, flaccid; the striæ and pigmentation still marked. The *uterus* is enlarged, as determined by bimanual examination; the cervix is soft, fissured, gaping, open, generally admitting the finger; muco-puriform discharges, perhaps tinged with blood,

[1] Gazette Méd. de Paris, 1852.
[2] Archives de Tocologie, 1876.
[3] Obstetr. Trans., 1883, vol. xxv.

escaping; the vagina large, flaccid, with free mucous secretion; the perineum lax or gaping, torn at the fourchette or beyond. Within the first week, these signs are especially marked; with the exception of the milk secretion, they tend to subside after a month.

During the first few weeks, the speculum will reveal a more or less intense red, "raw-looking" aspect of the vagina and vaginal portion, due to the process of restoration of the mucous membrane after the contusion of labor; more or less epithelium-shedding; and round the os externum there is almost invariably a circle of abrasion, with prominent villi from shedding of the epithelium at the part which bore the chief brunt of the bruising during the passage of the head.

2. The Signs of Recent Abortion.—The chief signs are: soft, relaxed vagina, free mucous secretion, enlarged uterus, dilated os, added to the "remanent conditions of early pregnancy."

The evidence of remote abortion is too uncertain to justify a positive opinion. But usually, as after labor at term, the vagina has lost much of the contractibility and rugosity of virginity.

Nulliparity.—The *negative* evidence consisting in the absence of the usual remanent conditions of gestation. The *positive* evidence consisting in small, smooth, conical vaginal portion, especially with minute os externum; with this there may be the lax vagina and vulva, indicating sexual relations. The *fallacies* are, however, important. First, we have known delivery at term to be followed by a condition of cervix and os externum that could not be distinguished from the virgin characters. The lax vagina and perineum may have been produced by sexual intercourse or masturbation.

Virginity.—Negative: absence of the remanent conditions of gestation. *Positive:* the presence of the hymen, a narrow, contractile vagina, persistence of the rugæ, a small, smooth vaginal portion and os uteri. Amongst the *fallacies* are: Surgical treatment or accident may have removed the positive signs; the hymen may survive sexual intercourse, gestation, and labor, whilst its absence does not disprove virginity.

B. **In the Dead.** *Past pregnancy at term. Recent*—that is, within a month or whilst involution is going on. In addition to some of the signs enumerated as evidence of recent delivery in the living, there is the corpus luteum in the ovary tending to cicatrization, the weight of the uterus exceeding 1200 grains, its length exceeding three inches; the anterior and posterior walls not in such close proximity as in the nulliparous uterus, the posterior wall more bulging, the fundus between the angles arched and rounded, perhaps peritoneal rugæ, mostly transverse on posterior wall near the lower portion; the uterine sinuses visible, some with clots or thrombi in them, breaking up; the mucous membrane not fully reformed, a line of demarcation at the os uteri internum; seat of placenta still marked as a projecting surface; the cervix still large, the arbor vitæ less distinct, free secretion, recent laceration of the os externum, generally on the left side; ecchymosis of the vaginal portion; serous effusion in the pericervical connective tissue. The *vagina* is lax, the rugæ are somewhat smoothed out, remains of ecchymosis, free epithelium-shedding. The *perineum* shows the recent wound of the fourchette or beyond, and probably ecchymosis and œdema of the labia vulvæ will be seen.

The *breasts* are enlarged; milk is found in the lacteal ducts.

After a month, the involution-process being completed or nearly so, the above signs are less conspicuous; the arched fundus uteri remains; the vaginal portion commonly remains fissured in lobes, thickened; the perineum may show cicatrices. The seat of the placenta may be traced for some time longer.

In the living and dead some fallacies have to be considered: Surgical treatment may account for fissure of the vaginal portion; the removal of large fibroid tumor or polypi may leave the uterus enlarged.

The *lineæ albicantes* or *striæ* have been already discussed as to their significance.

After *recent abortion.* The corpus luteum showing a cavity and surrounding vascularity according to the lapse of time from conception. The tubes, ovaries, and uterus show vascularity; the mucous membrane of the uterus exhibits a roughened surface from shreds of decidua; a serous or serosanguineous secretion bathes the uterine cavity and the tubes. The uterus is above the normal weight and size. The vagina is lax.

CHAPTER XXII.

ACCIDENTS OF PUERPERY—ACCIDENTS OF LACTATION: DYSGALACTIA; AGALACTIA; GALACTORRHŒA; CONGESTION WITH MILK; GALACTOCELE; MASTITIS; ABSCESS OF BREAST.

THE student is advised to refer back to the section on the "Anatomy of the Breast," and to the chapter on the "Puerperal Process," as a preparation for the study of this subject.

We have several times pointed out that a considerable proportion of mothers are not able to fulfil the last stage of the work of reproduction, that of suckling. The woman may have struggled through gestation and labor with tolerable success, but she can do no more. The breast-glands, which are really part of the glandular system of the skin, share in the want of development of this tissue, and in the general defect of glandular development throughout the body. Hence, when the call comes for the breasts to enter upon duty, one of these things happens: first, there is total or almost total failure to secrete milk: *agalactia;* or a futile attempt is made; the breasts become engorged; for a few days, perhaps, a scanty supply of milk is secreted, and then it stops; the breasts become flaccid, and "dry up;" the function has failed: this is another form of agalactia. Can anything be done to stimulate the secretion of milk when deficient? Generous diet, tonics, cod-liver oil, should be tried, on the general principle of nourishing the patient. The woman is in danger of being over-plied with stout. Certain special means are vaunted. Amongst these is the application of the leaves of the castor-oil plant. We have little faith in it. Another is persistent rubbing, with constant drawing of the breasts by the child or the pump. Some other agents are credited with galactogogic virtue. We do not discuss them, because we believe that milk-secretion depends upon, first, healthy nutrition of the woman; secondly, upon the development of the breasts and other glands. If one or other or both these conditions fail, it is a sin against physiology to endeavor to force secretion, after having given a fair trial of ordinary means, as good diet, gentle frictions, and drawing of the breasts. To excite the system and the breasts beyond this is to goad them beyond their capacity. It is like digging spurs into a jaded horse. It irritates and wears the woman, and may cause inflammation and abscess of the breasts. Or, again, the secretion of milk sets in with a rush; the breasts become greatly engorged with milk and blood; the milk escapes imperfectly, part being retained in the ducts, the excretory orifices being more or less obstructed.

Ratzenbeck says that a duct may be obstructed by accumulation of epithelium, and that this may be recognized by a very minute, white, projecting, translucent vesicle.

In some cases, again, the secretion is excessive and is freely excreted, more than sufficing for the child, and overflowing; *galactorrhœa.*

These three deviations from the healthy type may be said to be forms of *dysgalactia.*

In some cases, the breasts may be overpowered by the task imposed upon them. Engorgement leads to inflammation: *mastitis;* and mastitis commonly ends in *abscess;* sometimes, however, in *resolution.*

We must trace briefly the history of these events. In healthy women, capable of nursing, the flow of milk sets in on the third day. For the first day after labor no marked change in the size or firmness of the breasts is observed. In many cases, it is true, a little milk is secreted during gestation. This is evidence that the glandular structure is preparing for its function. But it is only when the uterus has accomplished its work, when the blood-current is turned off from the pelvis and determined to the new focus of energy, that the breasts start on active duty. On the second or third day there is almost invariably a marked enlargement of the breasts; they become harder and more prominent. There is active hyperæmia or determination of blood to these organs—a condition always observed in glands called upon to secrete. So far, then, the process is perfectly normal; and, on physiological reasoning, we should not anticipate any degree of febrility, any more than we should from the hyperæmia of the stomach and digestive glands after a meal. But it is matter of observation that on the second and third day the pulse and temperature often rise; this is attended or preceded by a slight tremor or rigor, which is followed by thirst, and perhaps by perspiration. These symptoms mark the so-called *milk-fever* or *ephemera*. In a day or two, when the milk flows, this febrility subsides.

Now an important pathological and clinical question arises: Is this febrile movement really due to the milk process? Is there, in short, such a disorder as milk-fever? Fordyce Barker says that, under proper care, milk-fever is an exceptional incident. Winckel denies it. The observations of Fancourt Barnes, made with great care in the British Lying-in Hospital, also answer this question in the negative. These observations show that in most puerperæ in healthy conditions there is no rise of pulse or temperature attending the establishment of the milk-secretion; and that where such rise occurs it may be traced to defective hygienic conditions: errors in diet, emotional disturbances, sepsis, or hospital influences. This, then, is what fever means: something wrong in the surroundings or in the internal organization of the patient. When rise of pulse and temperature is observed in more than one patient in a hospital, it strongly suggests that something is amiss in the hospital construction or administration. This something may be direct heterogenetic infection, or such disturbing influence of the excreting capacity of the patient as to favor autogenetic poisoning.

Believing as we do that milk-fever means obstructed excretion and a form of toxæmia—slight, it may be—we may describe the symptoms of the affection which passes under this name as follows: slight rigor, headache, flushed face, furred tongue, thirst and loss of appetite, heat and dryness of the skin (the temperature rising to 100° or 101° F.), quick pulse (100 or more), painful and distended breasts, sometimes to the extent of embarrassing respiration. These symptoms commonly subside within twenty-four hours.

Milk-fever may be prevented in most cases by careful attention to the hygienic conditions of the puerpera; by vaginal injections of hot water, carbolized or simple; by securing rest after the labor; by giving nutritious diet; by applying the child to the breast on the day following labor, before the engorgement has set in; relieving the bowels by a saline purgative; by giving the tonic antiseptic mixture of quinine, ergot, and digitalis. Dover's powder is sometimes useful. Gentle friction of the breasts from the circumference towards the centre may also be beneficial. If the fever persist beyond twenty-four hours, it becomes puerperal fever.

Mastitis.—Inflammation is apt to occur in any gland or tissue when, during the first impetus of physiological activity, some disturbing influence, as cold, violence, or obstructed excretion, intervenes. This is the more likely

ppen in women of a strumous diathesis. A strong predisposing cause morrhage at the time of labor.

mongst the immediate causes are: persistence in applying the child or breast-pump too soon after labor—that is, during the first twenty-four s, before milk is secreted; injudicious friction of the breasts; the pres- of cracks or fissures in the nipples; imperfect development or flattening e nipples. When these two latter conditions exist, attempts to suckle specially apt to cause inflammation. The openings of the galactophorous s may be obstructed; then engorgement in the ducts and in the proper dular tissue entails hyperæmia; hyperæmia easily passes into inflamma- and inflammation into abscess.

ere are *three kinds of abscess.* The *first* kind is *superficial;* its seat is een the skin and the superficial surface of the gland. It is generally l in its course; the constitutional disturbance is not great. It "points" The *second* kind is the *true glandular* abscess; it involves one or more es or lobes of gland tissue. The symptoms are severe. The great ching of the parts—the pus collects within the fascia of the organ—ces agonizing pain, throbbing, and enlargement. It is commonly at- ed by fever. After a time it "points." The *third* is the *submammary.* eat is the connective tissue behind the gland. It is slow in progress; the st proper is often free from implication; the constitutional reaction comes ; the pointing is slow. This form presents a remarkable appearance. breast is pushed forward by something behind it.

e breast is far from being affected equally or uniformly. One or more may be seized, whilst others remain free and continue their function of ting healthy milk. One breast only may be attacked. Nunn has drawn tion to the fact that the lower segment of the gland is twice as liable to e seat of suppurative inflammation as the upper. This is explained by ower segment being dependent, and there, the seat of passive congestion, lood and the milk are disposed to stagnate. This fact points to the ciple of the treatment, prophylactic and curative, of supporting the st from below. The two breasts appear to be equally liable.

e time when abscess occurs is, in the majority of cases, within the first months—more especially within the first. Nunn, analyzing 58 cases, essed the following formula: If we assume the liability to inflammation ng the first two months to be as 4, then the liability during the following n months collectively falls to 1, and for the period after the ninth month es to 2. The deductions from this are that, when the breasts have proved capacity by undisturbed work during the first two months, there is to fear; and that the inflammations which threaten after the ninth th are the result of over-lactation, and ought to be averted. Accepting latter proposition, the chief study must be directed to the prophylaxis of nflammations that arise during the first two months.

YPER-LACTATION.—It is convenient—although in opposition to chrono- al order—to dispose in the first place of the inflammations of protracted tion. What constitutes protracted lactation? The question hardly ts of a definite answer applying to all cases. As in so many other lems, the capacity for lactation is relative, varying with the individual. must, then, seek for the signs which denote that the term of lactation eached its limit. It is, perhaps, generally true that a healthy woman safely suckle for nine months; some go on without obvious distress for r, but few exceed that period without damage. A sense of weariness, akness, creeps on; the yield of milk falls off in quantity and quality; omes thinner, more watery; the proportion of oil-globules is smaller igs. 71, 72). If, under these circumstances, suckling be persisted in,

the system and the breasts alike are strained beyond their powers, and a slow kind of inflammation of the breasts, easily emerging into abscess, is very apt to set in. One almost constant sign of over-suckling is a weary, dragging aching between the shoulders. This is due partly to muscular weakness, partly to reflex action. Nunn shows that over-lactation leads to a spinal cachexia. This is marked by a peculiar dryness and chalkiness or opacity of the skin, drowsiness, loss of appetite, constipation, dyspepsia, incontinence of urine, physical and mental lethargy; the necessary task of weaning appearing to the patient to be one of insurmountable difficulty. The breasts become preternaturally large and flabby, the peripheral portions of the lobes being most engorged. Various neuralgic troubles arise. In the section on "Albuminuria" we cited the description by Power of the loss of accommodation of the eyes and other troubles of vision; deafness, also, is apt to occur or be aggravated. In one case seen by us the woman, under excessive suckling, became liable to fainting-fits. She lived poorly, and was frequently overworked. One day after dragging her infant for three or four miles, she went to bed much exhausted, and was found dead in bed. On autopsy, there were found general marks of anæmia; the blood itself was thin, scanty, and fluid.

Now it is obvious that these conditions—evidence as they are of exhaustion—indicate preventive treatment. If the system do not respond fairly to generous diet and tonics, no time should be lost before weaning. This course will be the more imperative if menstruation have returned, and if the child do not thrive.

We may now return to the subject of inflammation and abscess proper during the first two months after delivery.

Astley Cooper described the inflammation as adhesive in the first stage, suppurative in the second, and ulcerative in the third. This general proposition is of extreme clinical value. The glandular form of the affection is that which chiefly demands attention. One lobe after another may become inflamed, so that there may arise a succession of "knots" and abscesses. These, bursting or being artificially opened, may leave sinuses obstinate to treat. Sometimes the ulcerative process eats across galactophorous ducts, and then milk as well as pus flows from the sinuses: these are especially difficult to treat. Sometimes lobes of the gland, with connective tissue, become necrosed and form sloughs. In this way bloodvessels may be opened, and serious hemorrhage result.

Depressed Nipples.—When the child is put to ill-developed nipples, secretion being excited and excretion retarded, engorgement and inflammation are very apt to arise. This defect is often due to habitual pressure upon the nipples by ill-adjusted corsets. It is, therefore, one of the points to which "hygienic dress" should be directed. During gestation, careful attempts may be made to draw out the nipples by a breast-pump or by the application of an exhausted soda-water bottle. But this plan must be adopted with great caution, lest premature labor be provoked. It should be commenced within twelve hours after delivery, so as to prepare the nipple for the first efforts of the infant.

Fissures or cracks may occur independently of erosion or ulceration. The smallest fissure, only seen on minute inspection, is enough to cause agony in nursing. Rest is the first remedy; this is materially aided by the lead nipple-shields; and, during rest, touching with nitrate of silver and covering with collodion are of service.

Inflammation of the nipple may occur simply or as an attendant upon erosion, fissures, or cracks. Eczema is a rare affection. The best general treatment, applying to all the described affections, consists in great care in

emnants of milk after nursing, then smearing the part with
f liquor plumbi j, prepared calamine powder j, glycerine j,
j; then to protect the nipple by the lead shield; glycerine
ten a valuable application. Suckling is often made endur-
the child draw through an elastic tube fitted to a glass
Thus the direct dragging upon the sore nipple is avoided.
rious forms of SORE NIPPLES. Erosion or excoriation consists
ce Barker—in a superficial wound of the skin, the epidermis
y nursing. Sometimes there are little vesicles on the apex
nipple, which are broken by sucking; scabs form, and
les" result. Then the whole thickness of the skin is de-
ulceration. The surface then is bright red, granulated, fre-
, and grooved in fissures. Under this state nursing is acutely
ve seen half the nipple eroded under this process. The best
e nitrate of lead recommended by Wilson, of Glasgow. Bar-
s nitrate of lead gr. x–xx, glycerine ℥j. We have used it
ffect. Care is requisite to wash off the lead before putting
breast. In the early stage, after drying the surface with soft
e painted with the compound tincture of benzoin, or with
s an artificial skin is provided, under which healing goes on.
ceration proceed, weaning must be promptly enforced. Not
two of rest is enough; and then nursing may be resumed.
nflammatory stage of the glandular form there are nodulated
mps in the breasts," rendering lactation painful, and often
spension. This is the form which succeeds lacteal obstruc-
ment.
in which suppuration, sloughing, and sinuses occur, there is
tive fever, marked by chills, rigors, quickened pulse, loss of
d exhaustive perspirations. Vomiting and diarrhœa some-
licating absorption of pus or ichor from the suppurating sur-
ion ensues. Delirium, even mania, have been recorded.
with this fever there is a complication rarely, if ever, de-
is the puerperal condition. We are not dealing with a pure
the breast, but with inflammation accompanied and modified
l blood, laden with the *débris* of tissues undergoing involution
to be excreted. The breast should be an active participator
excretion. If it fail, greater strain is thrown upon other
probability of waste stuff being retained in the system is

sis is especially important as a guide to treatment. It is di-
the determination of the stage of the affection. In the first or
the breast is swollen, but it is not often so tense as to present
t; there is no spot showing special discoloration, and fluctua-
e out. In the second or suppurative stage, the appearance is
If the breast be completely bared, the prominence and ten-
surface and peculiar bluish color of the skin, in parts more
constitute enough to reveal suppuration, even without palpa-
out fluctuation. The ulcerative or sloughing stage is too
ed to require special description.
-The subcutaneous inflammation is of shorter duration than
. It does not often last longer than a week or two after the
d. The subglandular variety is more insidious in its early
s longer than the subcutaneous variety. It is usually more
luration of the glandular variety is more protracted still.

Different lobes being attacked successively, the affection is apt to drag on for weeks.

What is the influence of mastitis on lactation? Circumscribed inflammation of the connective tissue, the proper glandular tissue being free, may not arrest lactation. When the inflammation is diffuse, and the pus is discharged by several openings, the secretion of milk is usually arrested. But even in these cases the function may be restored after a while; and it may continue little disturbed in the other breast. Indurated masses may remain for some time after the abscess has closed. A few instances of death have been noted.

TREATMENT.—The first question is as to the continuance of lactation. As a general principle, an inflamed organ requires rest. But the rest from functional work need not in all cases be absolute. In many cases the breast continues to secrete, although the child is taken away. This is especially the case in the subcutaneous and subglandular varieties. A modified degree or form of lactation may be necessary to prevent milk engorgement. This is commonly best performed by the careful use of the breast pump, taking care to do no more than unload the disturbed tubes. Where one breast only is inflamed, suckling may, if not otherwise contraindicated, be kept up on the sound breast.

Can anything be done to check inflammation, so as to prevent its passing into the suppurative stage? In healthy subjects this can sometimes be accomplished. We have seen sucking do marked good. During the early or invading stage, the administration of two or three drops of tincture of aconite every hour or two hours is very useful in reducing the impetus of the circulation. Painting the breast with iodine; the local use of warmth and moisture by poultices or water-dressings on spongiopiline. But poulticing is often carried to excess. Belladonna has enjoyed considerable vogue. Beyond allaying pain its utility is doubtful. The dorsal decubitus as an aid to rest is of great importance. The engorgement is much diminished by the easier return of blood from the organ, especially from the lower part. This object is also promoted by direct support. At this stage straps of plaster containing mercury, lead, and belladonna, so applied as to lift up the lower part of the breast and keep up gentle, uniform pressure, are of eminent value.

Frictions, so commonly employed, are of limited application. In our experience we have frequently suspected them to be the cause of inflammation and abscess. Some nurses are apt to practise this behind the doctor's back, looking upon the care of the breasts as their duty or privilege. And thus, whilst the doctor is pursuing, as he thinks, the principle of rest, his efforts are being constantly thwarted by rubbings. If strapping answer no other purpose than securing against this practice, the plan has an incontestable merit.

There is, however, a time when judicious frictions are useful. This is *before* inflammation has begun, during the stage of engorgement, and to help the breast in its first struggle to secrete and excrete. It requires a gentle hand. Light frictions should be made, beginning from the circumference, and extended towards the centre or nipple; the guiding idea being to help the retarded milk onwards along the ducts to their openings. Olive oil, containing a little extract of belladonna, may be used.

During the stage of suppuration the great question is as to the time of opening the abscess. Opened it certainly ought to be in the great majority of cases. Spontaneous bursting is a tedious process; the pus may be very slow in working its way to the surface, the skin resists a long time, and in the meanwhile the abscess is extending, involving fresh lobes, and, pent up,

it burrows widely under the skin. The process of bursting is ulceration; and this process should be reduced to the minimum. Loss of skin by sloughing should be prevented; it is apt to leave an ugly scar. We should therefore meet the effort of Nature half way by opening the abscess. Yet it is not desirable to use the knife too soon. If we puncture before the proper moment, the knife must be plunged more deeply through tissues intensely vascular. Serious hemorrhage may result.

Pending the proper opportunity for incision, rest in the dorsal posture, and steady, not tense, support of the breast by a bandage or handkerchief are essential.

The proper moment is indicated by the thinning and blueness of the integument, and the detection of fluctuation. The best instrument is a sharp-pointed tenotomy knife. The incision should be made antiseptically. A drainage-tube will be useful if the abscess be in the upper part of the breast. But generally evacuation of the cyst is best attained by regulated pressure, so adapted as to keep the deeper part of the cyst-walls well in contact.

The principle of compression now finds its happiest application. It is best practised by using strips of mercurial and belladonna plaster about two inches wide, and long enough to seize the lower part of the breast, to pass over it, and to be made fast over the opposite shoulder. Beginning from below, and overlapping as we proceed upwards, pressure is made in the most effectual manner. An opening should be left at the seat of puncture. Occasionally a pad may be used next the skin, so as to fill up any depression and exert more direct pressure upon the cyst-walls. The best pads are Gamgee's disinfecting sponges. These sponges should also be used as a dressing to catch the discharged pus, and should be frequently renewed.

The strapping need not be removed or changed for three or four days, unless very severe pain announces injurious pressure upon inflamed structures. The strapping, properly applied, is not, in our experience, open to the objection sometimes urged that it impedes respiration. The plan has long been in use. Robert Barnes learned its use and the method of applying when attending the clinique of Trousseau. Hardly anything in surgery has given us more satisfaction. It shortens the duration of the suppuration in a surprising manner, and is the surest of all antiseptic measures.

When ulceration or sloughing has set in, pressure is still useful, but it must be applied more lightly. It may then be useful to paint the ulcerated surfaces with iodine or light solution of carbolic acid or chloride of zinc. We have found the old unguentum resinæ extremely beneficial. Nunn speaks very highly of the use of the galvanic current in the sequelæ of abscess, as sinuses, indurations, and œdema.

The constitutional treatment is of essential importance. It is based upon the known clinical principles. In the inflammatory stage, salines, aperients, and sedatives are indicated. When suppuration has begun, quinine, iron, sedatives are required. And throughout, the diet should be generous.

As a part of the treatment of mastitis, it sometimes becomes necessary to "dry up the milk." On this ground, as well as on other occasions, as in weaning, or when it is determined not to nurse, we have to inquire how best to effect this object. Belladonna has been credited with decisive power in this way. By some this power is denied. Braxton Hicks speaks highly of the efficacy of equal parts of extract of belladonna and glycerine applied to the breast, giving at the same time iodide of potassium in eight-grain doses. Tyler Smith extolled bromide of potassium.

To these means must be added saline purgatives and pressure upon the breasts. In cases of still-birth it is desirable to abstain from fluids.

CHAPTER XXIII.

THE PUERPERAL FEVERS.

No subject in the whole range of medicine is more fraught with interest than this of puerperal fever. Hecatombs of women and children have been its victims, yet in the vast majority of instances it is emphatically a preventible disease. If smallpox, scarlatina, typhoid, erysipelas are ever "stamped out," then will puerperal fever, in so far as it is dependent upon these diseases, also be stamped out. Not alone in this way, but in many others, puerperal fever is indissolubly linked with the most important questions in general medicine. It cannot be rightly understood by those who look upon it simply as a disease that attacks lying-in women. Nor, on the other hand, can its mystery be penetrated by those who have not made a clinical and critical study of obstetrics. No mere specialist can grasp the subject. No pure physician or surgeon can fully realize it.

Of late years puerperal fever has been a frequent topic of discussion. In Paris, London, New York, and elsewhere, the leading societies have discussed the various questions connected with it; a vast amount of clinical experience, of erudition, and of critical acumen has been brought to the task of elucidation. And still we cannot be said to have arrived at settled conclusions.

The first and fundamental question: What is puerperal fever? or, Is there such a thing as puerperal fever? is still under debate. This will be the first question to examine.

Starting from this point, we shall trace the peculiar conditions in the puerpera which make what may be called "the puerperal constitution." We shall inquire whether this constitution may itself generate a fever, and then we shall have to study how this constitution acts when a specific poison is introduced from without; and still we must examine how other poisons, not of a zymotic type, act and are reacted upon.

Having studied these preliminary questions which lie at the root of the question, we shall review the various theories of puerperal fever in the following order: 1. That puerperal fever is a disease *sui generis*. 2. That it is a putrid fever due to the absorption of foul matters from the uterus. 3. That it is the result of traumatism. 4. That it is a form of septicæmia, analogous to surgical fever. 5. That it is due to the invasion of the system by microscopical organisms.

In the next place, we shall trace succinctly the characters of the best-marked forms of puerperal disease, as: 1. The excretory puerperal fever. 2. Pelvic cellulitis. 3. Pelvic or puerperal peritonitis. 4. Thrombotic puerperal fever, and the related history of thrombosis, venous and arterial. 5. Metritis. 6. Metro-peritonitis. 7. Putrid infection. 8. The cadaveric toxæmia.

Then we shall study the relation of the zymotics to the puerperal fever—that is, of smallpox, scarlatina, erysipelas, typhoid, diphtheria.

We shall see that all these forms or varieties of fever are observed. And thus we are led to the logical conclusion that, if there be no such thing as one definite puerperal fever, we must recognize several puerperal fevers.

e question then, Is there a puerperal fever? must be answered: Yes, in e plural number. Meigs saw this, and wrote of childbed fevers. Arthur rre took the same view.

We shall, then, examine the *various modes of infection*—that is, the sources d manner in which the morbific poisons are introduced. This will lead us touch upon, 1. Epidemicity; 2. Convection by touch; 3, by air; 4, by thes; 5, by microbes and other modes.

Then we shall describe briefly the anatomical characters found in other ms of fever. Then the pelvic inflammations and phlegmasia dolens which ll have been pointed out in the special description of these particular ms.

Then we shall study the *symptomatology* of puerperal fever in its general ations, endeavoring to classify the symptoms with a view to the better preciation of their significance.

Then, following the same principle of supplementing special descriptions general deductions, we shall give a condensed summary of the *treatment*, ophylactic and therapeutical.

This section will close with a summary of conclusions, more or less abso- e or provisional, such as legitimately flow from the facts and arguments esented.

The history of puerperal fever is almost coextensive with that of the his- y of medicine. We cannot pretend in this place to trace it even suc- ctly. Could we do so, we should find in puerperal fever the reflection of ery doctrine prevailing in medicine from the days of Hippocrates. It st be enough to say that until recently the fevers of lying-in women were plained on the theory of solidism; and that the present prevailing theory based upon the hypothesis that the evil lies in the fluids. At the same e it is useful to bear in mind that the most recent prevailing theories may traced back to periods more or less remote, obscured indeed by different perhaps erroneous doctrines, and the technical language of the day.

The term "puerperal fever" was promulgated by Morton in 1718. The t ancient theory is that based upon the retention of the lochia and the mposition of the placental products. Hippocrates and Galen, Boerhaave, enham, Mauriceau, and Smellie, and most authors of the last century, ported this doctrine more or less confidently. Then there came the theory milk-metastasis. Willis, Puzos, and many others upheld this. At the inning of this century, Autenrieth set forth his physiological theory, which bines the two preceding theories. It may be thus stated: During ation all the fluids flow specially to the uterus, but after labor they are minated by the sweat, lochia, and milk. If these peripheral functions are errupted, the course of these juices is determined to the head, chest, and ecially the abdomen. This was widely accepted. Soon after this there ne the *gastro-bilious* theory, upheld amongst others by Denman.

Then came the *phlogistic theory*. The disease consisted in inflammation, ving its centre in the uterus, surrounding tissues, veins of the uterus and mphatics, intestines and peritoneum; or it was peritonitis simple.

Then there was the theory of erysipelas, of hospital fever, of putrid fever. Robert Ferguson appears to us to deserve a foremost place amongst those o have contributed to the establishment of the doctrines now most in favor. showed by experiments and clinical observation how all the accidents of rperal fever may be artificially produced by vitiating the blood. In rperal fever there are two sources at least of blood-vitiation: 1. The ct insertion of noxious matter into a vein. 2. Mechanical injury to the d walls of the bloodvessels. 3. And he contended that there was a third rce by inhalation.

Is there a Specific Puerperal Fever?—This question may conveniently be discussed on the basis stated by Sir Spencer Wells in the memorable discussion held at the Obstetrical Society in 1876. "Is there any form of continued fever, communicated by contagion or infection, and occurring in connection with childbirth, which is distinctly caused by a special morbid poison, and as definite in its progress, and the local lesions associated with it, as typhus or typhoid, scarlet fever, measles, or smallpox?"

A correlated question put is: "Excluding the cases of zymotics attacking puerperæ, may not all the remaining cases be referred to some form of surgical fever, or to erysipelas, caused by or associated with changes in the uterus and neighboring parts following the process of childbirth?" The answer postulated in this question would express the prevalent or favorite doctrine of the day.

Several of the most distinguished authorities of the last century believed that "puerperal fever was an essential disease."

Hulme (1772) says that: "Puerperal fever is a disease *sui generis*, as simple and regular in its appearance, for the most part, as any distemper incident to the human body. The pathognomonic marks are: acute pain and great soreness over the lower part of the abdomen, attended with fever, and commonly a pain in the forehead, happening soon after labor. These signs are sufficient to distinguish it from all other diseases."

Joseph Clarke (1790) is hardly less clear: "By puerperal fever I mean a disease which generally attacks women on the second or third day after delivery. Its ordinary symptoms are: a cold, shivering fit; acute pain in some part of the cavity of the abdomen, and great tenderness when pressed externally; a rapid pulse; and these soon succeeded by considerable distention of the abdominal cavity."

Armstrong, a physician of mark in his day, describing, in 1795, an epidemic which prevailed in Aberdeen in 1789–92, said: "It seemed in every respect to answer the description of the puerperal or childbed fever, on which many authors have written, particularly Drs. Hulme, Denman, and Leake. . . . . There is scarce any disease more regular in its time and manner of attack, or more uniform in its appearance and symptoms."

The uniformity of the disease is attested by Mitchell, who analyzed the histories of all the epidemics he collected, extending over a century, and prevailing in various countries. Peritonitis was the almost universal characteristic; in some it was metritis, or uterine phlebitis; in others, metroperitonitis.

The most conspicuous contemporary representative of this theory is Fordyce Barker. He and others rely upon the fact that fever begins before labor as evidence that it is an essential fever. He says that, in 1873, puerperal fever prevailed in the best class of society in New York, whilst in the poorer districts and hospitals the mortality was less than usual. But this evidence is ambiguous. We have seen numerous examples of fever in private practice taken before labor, assuming more or less epidemic characters. In some instances we traced series of cases of this kind following in the wake of the same practitioner or nurse, whilst women in the same localities enjoyed perfect immunity. One example was very striking. An excellent midwife of the Royal Maternity Charity had a series of more than thirty cases of fever among her charity patients and in her private practice.

The case thus stated will be further illustrated in the next section.

General Idea of; Definition; General Propositions.

The term "fever" implies toxæmia, or at least some departure from the normal constitution of the blood. The word "puerperal" of course expresses

process of childbed or "puerpery." If we bring these words together, n "Puerperal Fever," we need not imply more than fever in a puerpera. s general expression, vague as it is, and embracing many conditions vary- in kind and degree, is the most convenient and the least compromising t can be formulated. In this sense "Puerperal Fever" commits us to no ory or creed. It leaves us free to pursue the task of analysis by the light physiological, pathological, and clinical observation. In this way we hope to simplify a subject embroiled in conflicting theories, more or less itrary and exclusive; and to evolve out of confusion some clear and nite principles which shall serve for scientific classification and thera- tical indications.

. fundamental fallacy in the pursuit of the solution of the problem of rperal fever has been the search for one hypothesis, one solution. But laws of biology are not so simple. We must be prepared to accept many s, not hastily to reject any. We must study all authenticated facts in r individual significance, and in their aggregate relations.

eginning with the general condition, "Fever in a Puerpera," we shall seek to analyze by differentiation the various states which come under common denomination; and thus we shall the better appreciate the un- ying conditions, the special puerperal phenomena, which justify us in ling them all together into one group.

his is a strictly clinical method of inquiry. Coming to the bedside of a rpera with fever we at first recognize only the common signs of fever. n comes the question as to the nature of the fever. The solution of this often depend upon a knowledge of its etiology, and this in turn will n only be made out by investigation into the history of the case; and not om, history failing or leading astray, we are compelled to wait for the elopment of the symptoms, and for collateral information, which may not e until the illness is ended by death or recovery.

everting, for our immediate purpose, to the question: Is there a puer- l fever that has its own characters, its own laws, like scarlatina and its eners? In one sense the answer must be in the affirmative; in the sense ulated it must be in the negative.

et us get rid of this apparent ambiguity. Can the puerpera generate a ific poison that will produce a true fever in herself, capable of being pagated to others? This may be doubted. But certainly there arise in y puerpera processes which are peculiar to her state, and which, if dis- ed from their orderly course, may lead to fever. Thus, in the compara- histories we have given of the "Process of Gestation," and of the erperal Process," we see that the sudden revolution wrought on the ter- ation of gestation is marked by local and constitutional changes of the t striking kind. The local changes are, in the first place, traumatic, the ediate result of the violent process of labor; in the second place, the tegration of tissues in the uterus and correlated organs; in the third e, the altered condition of the blood, a compound of the blood of gesta- , into which is thrown the disintegrated stuff of involution, a kind of is which is ready at any moment to evoke inflammatory or febrile action, s elimination be impeded. In this sense, then, we have a fever *sui generis*, uerperal fever. This Robert Barnes long ago called *excretory puerperal r*, to signify fever from impeded excretion.[1] In the same place he styled disorder "Autogenetic," to signify that it arises in the patient's own em, in contradistinction from those fevers which were due to infection n without, and which he called "Heterogenetic." These terms have

[1] "Lectures on Puerperal Fever," Lancet, 1865.

become classic. But their full significance does not seem to be even yet appreciated.

The excretory autogenetic fever is the simplest form of puerperal fever.

Upon this form may be grafted: 1. The products of inflammatory action in the tissues of the parturient canal; 2. The products of decomposition or septic stuff on the surface of the parturient canal, absorbed from this surface, and especially from the wounds of the placental site, of the cervix uteri, and perineum.

This idea of the radical distinction between gestation and puerpery has been seized by Pajot, who says, "Nothing in the physiology and pathology of gestation resembles the physiology and pathology of puerpery. During gestation, all tends to hypertrophy; after labor, atrophy is the predominating symptom. The nosological line of demarcation is equally striking."

We assume, then, that there are certain *general underlying conditions* which modify all the febrile states to which the puerpera is liable. The following propositions may be stated:

1. Blood-poisoning in puerpery is:

A. *Autogenetic*, arising from processes inherent to the subject; or B. *Heterogenetic*, the result of infection from without.

2. The diseases of puerpery are diseases of low vascular tension, thus diametrically differing from the diseases of the gravida, which are diseases of high vascular tension.

3. So long as excretion of waste stuff keeps pace with its disintegration and absorption, the condition is physiological. This depends upon healthy organs, freedom from morbid diathesis, and from intercurrent disturbing influences.

4. When the physiological equilibrium between absorption and excretion is disturbed, waste stuff accumulates in the blood: there is toxæmia, and toxæmia entails fever.

Upon these general laws we may base the following summary of puerperal toxæmia. The particular poisons may defy chemical and microscopical analysis. But we are justified in describing two forms: 1. There is accumulation of lactic acid in the blood, the result of excessive muscular energy during labor. The researches of Helmholtz, Brown-Séquard, and Ludwig prove that decided changes take place in the muscles themselves under great exertion. Urea, carbonic acid, and water are discharged in consequence. Dubois-Reymond showed that the muscular juice, which, so long as the muscles are quiescent, possesses a neutral or faintly alkaline reaction, becomes after violent exertion decidedly acid. Lactic acid is thus formed and gets into the blood.

The nervous system also suffers. Bence Jones showed that abundance of phosphates are discharged after great mental exertion. Gamgee ("Edinburgh Veterinary Review," 1862), in an article on "Unwholesome Meat and Milk," says that cadaveric venom and animal poisons of undetermined nature may be developed spontaneously in health or disease. He is inclined to regard as the same deleterious principle, developed in an infuriated and overdriven ox, a passionate woman, the cadaveric venom of the human subject, or that of human beings or animals suffering many hours in labor, or from parturient fever.

The peculiar alteration of the blood, induced by severe nervous and muscular exertion, is further proved by the loss of muscular irritability. This is noted in overdriven cattle, animals hunted to death, soldiers killed in battle after a long fight. In these cases *post-mortem* rigidity comes quickly, is of short duration, and putrefaction soon begins.

. woman who has undergone a severe labor presents similar phenomena.
s we find in protracted labor a cause of autogenetic puerperal fever.
his blood-empoisonment is, perhaps, the earliest and the simplest form of
rperal fever; but it rarely exists alone. It is soon complicated with:
The accumulation of the waste stuff attending the involution of the
ine and other tissues brought into existence for the purposes of gestation
labor, and which, these processes being accomplished, have to be disin-
ated, absorbed into the blood, and discharged by the excreting organs.
lence we find a distinct source of empoisonment added to that which
ceeds from excessive muscular and nervous action. The case is now com-
ated. Still the toxæmia is autogenetic. These two empoisonments are
ns of endosepsis.
f the labor have not been severe or protracted, and nothing have occurred
heck excretion, this involution stuff is got rid of as fast as it enters
blood, and there is normal puerpery; no fever. But where the contrary
litions occur, there is a twofold toxæmia, and fever results. This two-
poison, and the attendant conditions, will underlie and modify all the
ases of puerpery.
Then there is a third form of self-empoisonment by absorption of foul
; the result of necrosis or decomposition of the tissues of the mucous
ace of the genital canal. This is *autosepsis*. Allied to this is the ab-
tion of putrid fluid or gases, the product of decomposing clot or placenta
ie uterus.
Then there is a fourth source of empoisonment, as by infection or
ulation of some foreign poison. This is *exosepsis*, heterogenetic.
hus we may understand that there may be a *simple* endosepsis, that auto-
is is grafted upon endosepsis, and exosepsis is a compound of all three.
hus we arrive at the demonstration of the fallacy so often uttered that
latina in a puerpera is scarlatina and nothing more. It is something
e. It is the foreign zymosis grafted upon the puerperal condition, and
ified by it. If the foreign zymosis do not find at the moment of its entry
existing autogenetic fever, this is instantly and necessarily produced.
the new poison at once disturbs the process of excretion.
We may here repeat a formula stated by Robert Barnes many years ago,
now generally recognized, which we believe to be of clinical, as well as
athological, value: Endosepsis produces a fever possessing little or no
ctive property; autosepsis and exosepsis are highly infective.
n the natural order we first study the history of autosepsis.
he factors of autosepsis breaking out into fever are: Predisposing con-
ons continued from gestation—as, 1. Hyperinosis. 2. Hydræmia. In
ition to the above normal conditions of the blood continued from gesta-
, there are certain abnormal conditions, as urinæmia and albuminuria,
æmia. 3. Lowered vascular tension. 4. Lower nervous energy, brought
at by shock and exhaustion of labor. 5. The traumatic injuries of labor.
The degradation of the blood by the products of excessive muscular and
vous work, and by the rapid absorption of œdematous serum from the peri-
ric connective tissue and elsewhere. Then we find another group of condi-
s that disturb the orderly course of puerpery: 7. Those that retard secretion
excretion, as chills; malarious influences; errors of diet, amongst which
fficient diet is one; bad hygienic surroundings, as too high or too low tem-
ature and bad ventilation; emotions. 8. Then there is a group, of conditions
supply a direct poison to the system, as foul stuff from retention of placenta,
s, or lochia in the uterus; the absorption of the cadaveric poison from
rying a dead child; the poison resulting from necrosis of tissue from long
ssure under protracted labor or instruments. 9. Another group of causes

will be found in the stases and congestions caused by pregnancy (C Braun). 10. The strumous diathesis, and other constitutional dyscrasiæ, especially predispose. 11. Then there often occurs a most powerful predisposing cause in hemorrhage. If this exceed in a marked degree the physiological amount, the rapidity and activity of the process of absorption are enormously increased; and any noxious matter in the tissues, or in the parturient canal, is more sure to be taken in. At the same time, the secreting and excreting energy being lowered, the absorbed noxious matters are almost sure to accumulate.

Sometimes associated with hemorrhage, but sometimes resulting from other causes, is a relaxed state of the uterus. This has been insisted upon as a condition of primary importance by some French authors, and in England by Graily Hewitt. It is undoubtedly in some cases a powerful predisposing factor. But it is sometimes secondary upon the fever. The patient may at first have had a well contracted uterus; then comes the fever, and following upon it is the relaxation of the uterus. Having premised this general description of the excretory puerperal fever theory, we may pursue the examination of the other theories that have been enunciated.

THE THEORY OF PUTRID ABSORPTION.—The favorite theory of the last century was that the disease arises from absorption of putrid matter. Kirkland thus expresses it: "There are other causes besides inflammation which bring on puerperal fever, for it sometimes happens that coagulated blood lodges in the uterus after delivery, and, putrefying from access of air, forms a most active poison—is, in fact, absorbed—and brings on a putrid fever." The same theory is expressed in nearly identical terms by White.

Clinical observation abundantly proves that a large proportion of autogenetic cases arise in this way.

Robert Ferguson injected putrilage into the veins of animals; phlebitis and typhoid symptoms followed. Semmelweiss performed similar experiments on puerperal rabbits. Denman and Van Swieten preceded Semmelweiss (1847) in advocating the doctrine now generally received, that every case of puerperal fever is to be looked upon as a resorption fever, excited by the reception of a decomposed animal matter, whether this be introduced from without or developed within the subject (*Selbstinfection*). This doctrine, says Spiegelberg, comprises in general all there is to be said about the origin of puerperal fever. And since, he says, the reception of the infecting stuff can only come from the wounded tegument, from a wound, so puerperal fever belongs to the order of ordinary wound-fevers, inasmuch as this idea embraces all the phenomena which arise in the entire organism as consequences of the local wound inflammation, and the local absorption of septic stuff.

The consideration of the *traumatic theory* cannot well be taken up apart from the *septicæmic theory*. Points of distinction may, indeed, be made out; but to some extent traumatism and septicæmia are conjoint factors. The conditions under which septicæmia may be held to work independently of traumatism will be pointed out. Traumatism alone cannot induce puerperal fever. Traumatism is universal, and fever is exceptional.

It appears to us that the term "traumatic fever" is entirely arbitrary. If it be assumed that the wounds made in childbirth never heal without undergoing an inflammatory process which sets up fever, the negative evidence of the vast majority of puerperæ, in this country at least, contradicts this assumption. These wounds, under good hygienic and individual conditions, heal without fever. In the German lying-in hospitals—the birthplace, we believe, of the traumatic theory—febrile irritation, more or less closely verging on declared fever, is no doubt common during the healing stage of the labor wounds. But this febrile movement is the expression of infection.

The term "traumatic fever," then, may properly be discarded as misleading. The wounds are inevitable, and if kept clean and the subject be healthy, are harmless. All sound prophylaxis is based upon this law. That hospital stands convicted of maladministration in which poison from without is allowed to enter by physiological wounds. Appeal to the hypothesis of traumatic fever is vain.

The appearance of erysipelas or diphtheritic membrane on the traumatic surfaces is no proof that the morbid process began on those surfaces. The rash of scarlatina, rubeola, is especially apt to break out with most intensity at the seat of injury. Thus, Paget says he cut a boy for stone; three days after he became very ill, but soon a viscid red eruption appeared at and about the wound. This was measles, earliest and most intense at the seat of injury, just as erysipelas might have been. He saw similar events with scarlet fever, and William Budd recorded a case of smallpox which appeared most intensely over a bruise on the nates. Thus, says Paget, "the local determination of erysipelas and of other allied diseases is no proof at all of their local origin or local nature. The same local manifestations happen in the truest eruptive fevers."

The *septicæmic theory* is that which holds, at the present time, the greatest sway. It is not inconsistent with the theory of infection by microbes; nor does it depend upon that theory. Its clearest exponents are Schroeder and Spiegelberg. Schroeder postulates first a wound. This is found in every newly delivered woman. Through some wound in the parturient tract a poison is introduced. If there is no wound, there is no infection. If the wounds remain in their simple state, granulating, there is no evil, or at most the accidents are purely local, simply inflammatory. But if infection touch these wounds, then there is propagation of the inflammation, empoisonment of the woman, and the series of phenomena called puerperal fever.

Spiegelberg sets out a similar hypothesis. He says: "Every wounded tissue is, at the seat of the injury, necrotic tissue. Around this there arises inflammatory reaction, which spreads to surrounding tissues, but which is less intense in proportion to the distance from the centre. This inflammation favors the resorption of the necrosed particles. Even when a violent crushing has taken place, the crushed tissue does not die off, but is absorbed through the reactive surrounding inflammation. But if germs of putrefaction come into the wound, then through their action the wounded tissue dies off, and these germs now excite wound-suppuration and *wound-fever*."

It is quite different when the so-called "septic" poison is brought to a fresh wound, infects it, or when such poison first forms upon the suppurative surface. Then this is of a nature quite distinct from the simple putrefactive matter, and it operates differently. It is not destroyed by the living tissues, as the putrefactive germs commonly are, but it spreads from the place of reception throughout the body, and there chiefly multiplies. The postulate that the poison can only enter through a wound is disproved by facts. Thus the septicæmic theory as stated by Schroeder falls to the ground.

In a recent discussion in New York the septicæmic theory was almost universally accepted. Thus, Thomas, Lusk, and Mundé affirm that puerperal fever is puerperal septicæmia. The most remarkable dissentient is Fordyce Barker, who still adheres to the opinion expressed in his work that puerperal fever originates from epidemic causes, from contagion and infection. He believes in septicæmia from nosocomial malaria and direct inoculation.

Hutchinson submits that the term "septicæmia" ought to be applied to the result of poisoning of blood induced by the inflammation of the patient's own tissues. We very often get symptoms of septicæmia in cases in which there has been no possibility of their being produced by morbid poison from

without. He admits the influence of morbid matter as an irritant in setting up inflammation; but he believes that the stage of gangrenous inflammation of the part is one which is essential to septicæmia. Local injury is an accident which may start the septicæmia. But for this to arise presupposes a peculiar state of the blood. The prick of a needle, the sting of a bee, the most trivial operation, may, in some states of the constitution, prove fatal. Healthy persons may resist a poison even which would do fatal mischief in certain unhealthy states. Thus, vaccination in healthy subjects may set up a perfectly regular zymosis: whilst in certain unhealthy subjects erysipelas, or diffuse cellulitis, may follow. And we may use the analogy of vaccination in further illustration of the peculiarities of gestation and puerpery. Just as gestation and puerpery may evoke any latent morbid diathesis, so that these conditions become tests of the soundness of the subject, so may vaccination evoke latent morbid proclivity, as syphilis. When this happens, the lymph used for inoculation is too readily accused of carrying the syphilitic poison with it. What do we know of the interreactions of two or more poisons circulating together? Very little. But the history of fevers in childbed certainly shows that one or the other poison is modified, and it is quite possible that a new one may be produced.

An interesting illustration of this view is given by Hutchinson in a valuable memoir, "Causes of Death of Ewes after Parturition" ("Obst. Trans.," 1877). He observed that ewes, whilst giving milk, became liable to a sort of idiopathic tetanus, if fed upon "cotton-cake." The same food given to lambs, hoggets, and undelivered ewes produced no ill-effects. It seems, then, a clear proof that a noxious irritant was produced by a substance taken into puerperal blood, which in non-puerperal blood was harmless.

In this connection we may cite, as examples of the part played by traumatism and septicæmia, cases of adherent placenta, in which more than usual injury was inflicted by the forcible detachment, perhaps incomplete, of this organ, Hegar,[1] Hüter,[2] and others have satisfactorily proved this source of danger. In some cases a piece of placenta remains attached, forming the "placental polypus." In such cases septicæmia is easily set up.

Stadfeldt relates a case which suggests another view. A 1-para was delivered in hospital, after fifty-two hours' labor, of a dead child. Signs of metritis were observed during labor. She died on the third day. Autopsy revealed peritonitis, metrophlebitis, endometritis; the uterus imperfectly contracted, the inner surface covered with an abundant, partly puriform, partly chocolate-colored mucous layer capable of being scraped off. In the left superior angle of the uterus was attached a bit of placenta, the size of an egg. Stadfeldt says, it cannot be denied that the same process in the uterus which was the cause of the adhesion of the placenta gave rise to the unusually early and violent occurrence of the puerperal fever. The fever was caught in the hospital before labor.

Analogous to these cases of placental retention are those in which fibroid tumors, embedded in the uterine wall or projecting into the cavity, have complicated labor. In some of these cases, especially if the tumor have been attached to the fundus of the uterus, no trouble may result. In a second class of cases the tumor undergoes crushing, bruising, even tearing, during labor; it is then apt to fall into necrosis, and a bad form of septicæmia is set up. In a third class, the tumor may have undergone no injury, but, being compressed by the contracting uterus after labor, its supply of blood is suddenly diminished, it falls into necrosis, and septicæmia results.

[1] Pathologie und Therapie der Placentaretention, 1862.
[2] Die Mutterküchenreste. Monatsschr. f. Geburtsk., 1857.

We have seen examples of all these conditions. Chiari, Braun, and Spaeth relate a case ending fatally on the second day of *endometritis sphacelosa* following labor with fibroid tumor in the uterus, secale having been given. This is a case in which secale ought not to be given.

The identity of puerperal fever and so-called surgical fever is held by many. The question was formally put by Spencer Wells as the basis of discussion by the Obstetrical Society of London. It falls within the discussion of traumatism and septicæmia.

That there are many points of analogy is undoubted; but there are also points of difference which forbid us to accept the doctrine of identity. The subject of an amputation, and a woman after labor, both present wounds. Both may be considered as susceptible to invasion by poisons. In both the poison may effect a lodgement on the wounds. But it is easy to carry the comparison too far. Amputation is presumably performed on account of disease. The condition of the patient is pathological to start with. There is no special provision in the system made for the express purpose of healing the wound. The wounds in the puerpera are physiological. There is a distinct provision *ad hoc* for restoration to the ordinary state. It is in this provision, marked by extraordinary activity of absorption and excretion, that lies the peculiarity of the puerperal state. This condition has no parallel in the ordinary surgical patient.

And if we accept, for the occasion, the comparison between the surgical and the puerperal patients, the case is far from being so much simplified as is assumed. If we are asked, What is puerperal fever? may it not be asked in return, What is surgical fever? Is surgical fever one uniform, definite, pathological entity? Would it not be a truer statement to say that, just as puerperal fever can only be accepted as a general term to signify fever in a puerpera, so is surgical fever a general term to signify fever in a surgical patient? In neither is the fever one constant thing. There are varieties of surgical fevers as there are varieties of puerperal fevers. If it be contended that by surgical fever is meant septicæmia and nothing else, this is simply begging the question; we must still ask, What is septicæmia? And again, if surgeons are prepared to give a precise definition of septicæmia in surgical patients, are they also prepared to show that a septicæmia of the same character is produced in lying-in women? Septicæmia is a compound term. There is the sepsis, the poison; there is the blood which receives the poison. Now, if it be possible to show that the sepsis in the two subjects is identical, it would still be necessary to show identity or near similarity in the recipient blood. The first term of the proposition is certainly not proved; the second is certainly not true. This theory, then, like that of the microbists, is too absolute and exclusive. It may account for a large number, perhaps the greater number, of cases in lying-in hospitals; but it does not account for cases beginning before there is a wound, nor for the propagation to non-puerperal women.

The Theory of Empoisonment by the Agency of Microscopic Organisms: Bacteria; Micrococci; Microbes.

This theory, gradually developing since the researches of Mayrhofer, especially in 1865, has now acquired consistency, if not as an all-sufficient explanation of the production of puerperal fever, at least as an important factor. Mayrhofer discovered in the lochia of sick puerperal women moving vibriones, which he declared were the cause of the intoxication. Recklinghausen and Waldeyer showed the presence of these vibriones, not alone in the lochia, but on the surface of puerperal wounds, in the uterine lymphatics,

in the infiltrations of the connective tissue, in the exudations of the serous cavities; and demonstrated that the bodies with fine nuclei described by Virchow and Hohl were moniliform bacteria. Several observers pursued this course of investigation. But it is to Pasteur that we owe the clearest and most definite conclusions.

We borrow from Charpentier,[1] who has given the best review of the subject, the following summary of Pasteur's doctrine by Raymond: "When the lochia of a puerpera in good condition are examined, few or no microscopic organisms are found. But if the lochia of a woman threatened with puerperal disorder are examined, one is struck by the abundance of the organisms; and, if death happens, the same organisms which had been observed in the lochia are found in the pus of the peritoneum, in the uterine lymphatics, in the pleuritic effusions, in metastatic abscesses, in the visceral suppurations. Pasteur even succeeded in proving, by his processes of culture, that the blood of affected women, even before death, contained microscopic organisms. Further, Pasteur was able, by the simple examination of the lochia for organisms, to predict an attack of fever before the most searching clinical observations of the physicians awakened suspicion of evil."

The particular organism described is the *chapelet en grains*. But Pasteur says this particular form is not the only one found. Puerperal fever, he says, has no special microbe. There are several forms. The noxious organism is cultivated abundantly in the lochia, in the uterine cavity. The peritoneum, being contiguous, is penetrated by it; there it is cultivated, and produces, by its rapid multiplication, the peritonitis with pus filled with the organisms. If the medium offered by the peritoneal cavity is not favorable to this organism, the disorders are more limited. Instead of intense general peritonitis we shall see pelviperitonitis of slower course. But successive invasions from the uterine cavity render it difficult to cure.

"It is thus easy to understand the cases of phlebitis and pelviperitonitis. It is the situation of the wound, the connections of the uterus, which increase the danger; and it is this alone which is peculiar to the puerpera, distinguishing her as a specially wounded subject. Let the microbe come, having before it so many open doors, be it an infective organism of the nature of the septic vibrio to which Pasteur attributes the special septicæmia which he has studied in animals, the disease will take the infective and rapid form, and we shall witness those cataclysmic deaths which have so often desolated lying-in hospitals. The blood then presents the characters observed in typhoid diseases.

"When we consider the variety of forms presented by puerperal fever, it is difficult to admit that it is caused by one infecting agent, one microscopic organism."

That micrococci exist in the living body and play an important part in the morbid process is made evident from many observations, and especially from the following case recorded by Lomer. A 9-para, on account of placenta prævia, was delivered by turning and extraction. Twenty-four hours later she had a chill, and peritonitis set in; then followed diffuse phlegmon of the right labio-crural region, phlegmon of the lower part of the left leg, with varicosities in a state of superficial gangrene, and diffuse phlegmonous swelling of the right hand and lower part of the right arm, also exquisite euphoria. Death on the fifth day. Blood drawn during life was crowded with chain-like micrococci. One hour after death, a necrotic endometrium with purulent peritonitis was found. Micrococci were found in the pus and in the liver and kidneys. Micrococci have also been found in pemphigus vesicles.

[1] Traité pratique des Accouchements, 1883.

Coze and Feltz made hypodermic injections of blood taken from puerperal-fever patients in rabbits. Most of the animals died of diarrhœa and convulsions. Eberth inoculated the corneæ of rabbits with croupous exudations from women who had died of puerperal fever, and found that the diphtheritic process was continued upon the cornea, and that the matter contained micrococci.

Still the question returns: How are these infective microbes introduced? The answer, that they attack the wounds caused in labor, does not cover the whole case. For some women are attacked before labor; and the great majority of women, notwithstanding those wounds, escape puerperal fever. And how, it has been pertinently asked, do the organisms find entrance in those most terrible cases of all in which death follows in a few hours? The uterus, fully contracted, has left no gaping mouth; the lochia have not been fetid; there has been no phlebitis or lymphangitis or phlegmasia of any kind. What open road have the microbes found to invade, not alone the puerpera and the child she bears, but also the nurses and the midwives who are living in the midst of lying-in women? But these last are seized notwithstanding, and present the peritonitis so characteristic of puerperal infection.

The conclusions of Pasteur are not uncontested. Thus, Artwing, in a recent communication to the *Société des Sciences Médicales* of Lyons, whilst verifying the association of microbes with puerperal fever, maintains that the different forms of puerperal septicæmia are all due to the action of one living poison; that there is only one microörganism concerned; and that this has not been proved to be special to the puerperal state. Lomer[1] states the following conclusions: "In puerperal fever, in erysipelas, in scarlet fever, in diphtheria, and in the secretion of wounds, chain-like micrococci are found which have as yet not been proved to possess individual differences. But it may hereafter be shown that there are different kinds of chain-like micrococci, that each kind has its distinct and specific action."

When in any case of puerperal fever the presence of these micrococci has been detected in the exudation, they have also been found in the deeper organs.

Other microörganisms may be present, but their presence in the dead body does not always prove that they existed in the living body; they are often the result of post-mortem decomposition.

It is as yet impossible to classify puerperal fever as regards course and prognosis according to the varieties of the microörganisms found (Doléris), or according to their mode of invasion (Fraenkel).

We will now sketch the second form of puerperal fever, taking first the more typical autogenetic fevers.

1. First of these is the simple *excretory puerperal fever*. This has been sufficiently described.

2. *Pelvic Cellulitis or Parametritis; Pelvic Peritonitis or Perimetritis; Metroperimetritis; Inflammation of the Broad Ligaments. Salpingitis. Colpitis.*

Sometimes toxæmia reveals itself in general systemic disturbance; sometimes inflammatory complications constitute the most conspicuous feature. It may be taken as a general fact that, where acute inflammations occur, the general blood poisoning is less severe, or that the condition of the blood is sounder, more able to resist the noxious action of the invading poison. Thus, we may, in most cases, look upon pelvic cellulitis and pelvic perimetritis as evidence of a reserve of power in the subject, which may carry her through

[1] "Our Present Knowledge of the Relations between Microörganisms and Puerperal Fever." Amer. Journ. of Obstetrics, July, 1884.

the trial. The disorder is localized, whereas in extreme cases the entire system is overpowered.

Inflammation is rarely limited to one tissue. Hence the danger of error from adopting in their strict sense the terms "perimetritis" and "parametritis," or equivalent terms. Commonly, inflammation of the connective tissue of the broad ligaments is complicated with pelvic peritonitis. Is there such a state as pure inflammation of the pelvic tissues after labor? We doubt it, believing that a toxæmic element is always concerned. Not only may the connective tissue and peritoneum be the seat of inflammation, but the substance of the uterus itself may be inflamed = metritis; the vessels, especially the veins = phlegmasia; and the lymphatics = lymphangitis.

It is a general law that organs that have been recently engaged in active or extreme physiological work are especially susceptible to inflammation. It is interesting to inquire which tissue is the first to be attacked. Postulating, as we do with some confidence, that the immediate cause of inflammation is an irritating matter carried in the blood, we shall naturally conclude that the inner coats of the vessels, the veins and lymphatics, will be the first affected. The venules and lymphatics are the direct recipients of foul matter from the inner surface of the uterus or other traumatic urea. Accordingly we find the vessels almost invariably affected. By contiguity, the morbid process extends to the substance of the uterus: myometritis; thence to the vessels and connective tissue of the broad ligaments, and thence to the investing peritoneum. The greatest virulence of the inflammation is often spent upon the cellular tissue. The plastic or adhesive character of the inflammation of this tissue serves to limit or to localize it here. There is a marked analogy in this condition to that of thrombosis, which we shall presently describe. It is probable that in many cases, at least of so-called pelvic inflammation, the initiative condition is thrombosis. The order of events is as follows: 1. There is irritating matter on the placental site or other part of the uterine surface. 2. This matter is absorbed into the venules and lymphatics. 3. Coming in contact in these vessels with hyperinotic blood, in a state approaching stasis, the fibrin is precipitated, forming thrombi. 4. The irritating matter retarded in the vessels sets up inflammation in the walls of the vessels, whence it extends to the connective tissue and peritoneum, as already stated.

Thus we see that pelvic inflammation is a conservative process, limiting or controlling the spread of poisonous matter into the general circulation.

We may analyze the cases of pelvic peritonitis into three principal varieties, always bearing in mind that there is no rigorous line of demarcation. 1. There are cases in which inflammation is not obviously complicated. Th will tell more especially upon the peritoneum. After extreme physiologic activity of the uterus, its investing membrane—like the pleura—may, unde a sudden impression of cold or violence, become inflamed. The influence c cold is well illustrated in some cases, where the abdomen has been kep swamped with cold water or ice after labor, or where ice has been applie inside the uterus. Violence in the shape of rough "kneading" to expel th placenta and to arrest hemorrhage is also very apt to cause inflammation We have known it to be caused by coitus forced upon the woman within few days of labor.

Symptoms and Course.—It rarely manifests itself before the third day and it is interesting to note that the process of involution, disintegration and absorption is only beginning about this time. This fact has a wid application in the study of puerperal disease. On the other hand, the susceptibility continues for an indefinite time. Inflammation may break ou when an adequate exciting cause is applied. Thus, a young lady of del

cate organization suckled imperfectly for seven weeks; whilst menstruating she underwent great fatigue, and came home with intense abdominal pain and fever. This is not an uncommon history. It points to the analogy between labor and menstruation. In such cases the inflammation is primarily peritonitic.

But not even in all these essentially inflammatory cases is the inflammation expended upon the peritoneum. There is a group of cases in which traumatism appears to be an essential factor, in which the chief, or at least the primary, seat appears to be the perimetric connective tissue. During the passage of the child's head through the parturient canal there is commonly laceration of the cervix uteri, bruising, even crushing, of the mucous membrane, attended by a dragging or glacier-like movement of the structures in most immediate contact with the head upon the subjacent tissues. The cellular tissue around the cervix is especially contused, stretched; vessels in it are torn; hence effusion of serum and ecchymosis. All this we have frequently verified by inspection. Everything is prepared for inflammation. The local injury, the effusion, the hyperinotic blood charged with effete matter, are there; an exciting cause is alone wanting. A chill is sufficient. The chief seat of inflammation is the wounded cellular tissue. In this tissue it may run its course, ending in resolution or in abscess, the peritoneum being, perhaps, only slightly implicated.

In another order of cases, characterized by the predominance of a septic factor, the inflammation of the pelvic tissues is universal. The uterus itself, its bloodvessels and lymphatics, the connective tissues around them and in the broad ligaments and the peritoneum, are all involved in inflammation of a low type. The inflamed peritoneum, throwing out unhealthy lymph, which rapidly breaks down into pus, sets up the like inflammation in every part of the abdominal peritoneum with which it comes in contact. Septicæmia attends, constituting a form of autogenetic puerperal fever. Endosepsis and autosepsis are combined.

A still more complex order of cases are those in which poisonous matter is inoculated from without. The poison of some zymotic, erysipelas, or the septic matter from another puerperal woman, pus or ichor from a wound, or the cadaveric poison is absorbed by the traumatic surfaces left by labor. This constitutes a form of heterogenetic puerperal fever. In this order of cases the disease commonly breaks out early—on the second or third day. There is general blood infection; fever of a low type—"typhoid" it is sometimes called—is apt to carry off the patient in a few days, perhaps before any marked local inflammation can be produced.

We may still recognize a mixed order of cases, in which there is a septic factor, controlled by a comparatively healthy state of blood. The inflammation begins in the uterine sinuses and lymphatics. Under the combined influence of traumatism, of blood impaired by the tissue changes of puerpery, and sometimes of decomposing *débris* of placenta, membranes, and blood-clots in the uterine cavity, foul matter gets into the uterine sinuses and lymphatics, and, not arrested there, from want of contractile energy in the uterine fibre, or because being as yet too abundant for the blood it meets in its course to segregate by coagulation, it invades the vessels in the broad ligaments, where further progress is stayed by the formation of clots. This thrombotic process is generally attended by inflammation of the perivascular tissues and of the broad ligaments. If the lymphatics be concerned as well as the veins, then the phenomena of phlegmasia dolens are developed. In this order of cases the symptoms declare themselves later than in the preceding order. It may take a week, or even a fortnight, before the signs of thrombosis become clear.

That the broad ligaments are chiefly involved in the majority of these cases seems proved by the seat of the tumefaction being in the sides of the pelvis; by the inflammation being in many cases unilateral, the side affected being usually that in which the placenta was attached, or frequently the left side, being that on which the cervix uteri was fissured by the occiput in labor. This latter source of pelvic cellulitis has been much insisted upon by Whitehead and Emmet.

Trousseau may be cited as insisting upon the frequent complication of phlebitis with inflammation of the broad ligaments.

A very similar description will apply to the perimetric inflammations of abortion. It applies often very closely to inflammation of the broad ligaments, leading to phlegmasia dolens, beginning in cancer of the cervix uteri.

The Fallopian tubes may become inflamed, perhaps primarily, but certainly by spreading from the vagina and uterus. This is especially seen in *peritonitis meretricum*, in which the starting-point is gonorrhœal infection. In some cases of this origin, the tubes become distended by pus, and this is poured into the peritoneum either by rupture of the tube or overflow by the fimbriated extremity. The ovaries, first catching the foul irritant, are sure to be involved. In like manner, a simple puerperal endometritis may spread to the tubes; or the tubes may first become inflamed from foul matter being generated in them or taken up from the uterus.

It is remarkable that gonorrhœal peritonitis may break out after childbirth. Mr. Giles[1] relates three cases of this kind. Dr. Emil Noeggerath[2] discusses this subject in an elaborate memoir. He submitted that gonorrhœa, apparently cured, may linger in certain portions of the generative organs for life, constituting "latent gonorrhœa;" that in this form it may infect a healthy person with acute gonorrhœa; and that in the female it may pass from the latent into the apparent form, giving rise to acute, chronic, or recurrent perimetritis or ovaritis. Dr. Macdonald[3] followed up the subject. He discusses Noeggerath's opinions, and gives some interesting cases of his own. He says that in cases of gonorrhœal puerperal endometritis, "the discharge during the acute attack is very characteristic. It is not like the ordinary lochia at all. It is thin, sero-purulent, and exceedingly profuse at first, and then becomes less in amount, yellow in color, tough in consistency, and excessively offensive to the smell."

The suspicion of a case of this kind would be an urgent motive for practising intrauterine injections of iodine.

Salpingitis Puerperalis.—A condition not seldom observed in connection with puerperal fever is inflammation and suppuration of a Fallopian tube. This condition has been described by Ed. Martin (1851), F. Howitz (1858), Förster (1859), Vocke (1860), and since those dates by several authors. R. Barnes published ("Obst. Trans.," 1862) a case following induced abortion, with historical notes of the subject. It may be a part of the morbid process, as when it is associated with metritis; then there is metro-salpingitis. Or it may constitute the principal feature of the case. The great danger attending it is the rupture of the distended tube, and the sudden escape of the offending contents into the peritoneum. Or there may be overflow from the fimbriated end of the tube. The late Professor Martin, of Berlin, related several cases.[4] He says it does not always begin in the

[1] Brit Med. Journ., 1871. [2] Bonn, 1872, and Amer. Gynec. Trans., 1876.

[3] Latent Gonorrhœa with Special Relation to the Puerperal State, 1873.

[4] Ueber Mutterröhrenentzündung und Erguss des eitrigen Sekrets derselben in die Bauchhöhle. Monatssch. f. Geburtsh., 1859–1861.

puerperal week, but sometimes during gestation—sometimes, indeed, before the actual pregnancy. He thinks in one case it began in blennorrhœa.

When escape of pus takes place there is sudden acute pain; fever follows, and tympanitis, which obscures to some extent the peritonitis. If death does not follow when involution of the uterus has made progress, the enlarged tubes may be felt. It is not probable that a cure is effected, and in the chronic state, danger of bursting or extending peritonitis is always impending.

It appears to us that these are cases in which Lawson Tait's operation—the removal of the diseased tubes—may find legitimate application.

Phlegmasia Dolens, or Thrombosis: Thrombotic Puerperal Fever.

The history of phlegmasia dolens naturally follows upon that of pelvic inflammation. Phlegmasia dolens, like perimetritis, is a variety of puerperal fever. It is a toxæmic disorder. It is most commonly autogenetic. The toxæmia is localized or limited. The two conditions are closely linked in genesis and nature. They arise in similar conditions; and it may be held that at the moment of invasion it is uncertain what form the disease may assume; accidental conditions, not clearly defined, may determine the evolution into perimetritis, phlegmasia dolens, or general septicæmia.

We have seen that in one form of perimetritis, in which the septic element is marked, but not overwhelming, the quality of the blood is so good that it resists the transit of the septic matter, and isolates it in the pelvic tissues. A similar event also happens in phlegmasia dolens. Both in this respect are conservative processes. The blood, clotting under the precipitating power of the poison, shuts it out from the general circulation. On the other hand, when the system is depressed, the blood poor, and the supply of septic stuff is copious, virulent, and sustained, the clotting virtue of the blood is overwhelmed and general toxæmia takes place. The thrombotic process is inefficient; the imperfect clots break down in suppuration.

The name "phlegmasia dolens"—an arbitrary compound of a pathological hypothesis and of a symptom—would be inadequate, even if it were not based on error. That the veins in the broad ligament and the femoral vein are commonly inflamed is true. But this is not the essence of the disease.

It is convenient at the outset to enumerate some *of the theories* which have been held: Mauriceau thought phlegmasia dolens was due to suppression of lochia; Puzos and Levret thought it due to metastasis of milk; Dr. Hall thought it consisted in general inflammation of all the tissues of the affected limb, whence coagulable lymph was thrown out into the cellular tissues; White, of Manchester, a remarkable clinical observer, said it was due to obstruction of the lymphatics; Ferrier attributed it to inflammation of the lymphatics; this view was adopted by Hamilton, Gardien, and others; D. D. Davis, recognizing the clotting in the veins, advocated the pure phlegmasic theory, contending that the disease consisted in inflammation and obstruction of the principal veins of the extremity; Bouillaud and Robert Lee adopted this theory, and it was generally accepted.

The right path was first struck by Gulliver, who showed the conditions under which blood coagulates in the veins. He especially described the process of change into pus-like fluid which takes place in the interior of the clot, distinguishing it from suppuration. In this he was followed by Virchow. Henry Lee (1852) made important experiments showing how difficult it is to cause inflammation of veins by any irritants; that irritants act by causing the blood to coagulate. Gaspard's experiments told the same

thing. Henry Lee's proposition, "that no one has satisfactorily demonstrated the presence of an inflammation limited to the lining membrane of a vein," is still justified.

We must not, however, forget that thrombosis may be the result of embolism. Thus, J. Y. Simpson relates the case of a woman who died of phlegmasia dolens of the left arm and side of the face some weeks after an exhausting labor. After delivery she had signs of embolism, first in the right brachial artery, and then in both legs; then came on phlegmasia dolens in the left arm. The aortic valves were covered with wart-like excrescences. It was suggested as probable that fibrinous detritus passing from the arteries into the capillaries and veins of the left arm caused phlebitic thrombosis.

The more recent researches of Mackenzie and Tilbury Fox give precision to the foregoing observations.

Mackenzie (1861) proved by one set of experiments that inflammation produced in veins caused none of the phenomena of phlegmasia dolens; and, by another set, that when phlebitis was caused by vitiating the general mass of the blood, the phenomena of phlegmasia dolens ensued. Tilbury Fox (1862) came nearer to the mark when he showed that obstruction of the main lymphatic channels is alone capable of giving rise to white leg, acting by preventing the removal of lymph from the affected limb. He further illustrated this by pointing out that the character of the swelling is not that of serous stasis produced by blood disease, the enlargement being unequal and commencing above and extending downwards. He said it was due to sudden absorption of acrimonious fluids.

There is an element of truth in all the above theories. If we interpret the ideas of "suppression of lochia" and "metastasis of milk" as implying arrest of secretion and excretion, and therefore the accumulation of noxious stuff in the blood, we recognize a true factor; that there are phlebitis and venous obstruction is certain, although these are secondary or tertiary features; that there is obstruction of the lymphatics, is now abundantly proved.

This preliminary statement made, we may now pursue the clinical study of the affection; and thus, out of the phenomena observed at the bedside and in the dead-house, we shall endeavor to evolve a consistent theory that shall harmonize with facts, and give us sound principles of treatment, prophylactic and remedial. We may first put and answer the question: Why is thrombosis so preëminently venous? The reasons are, that venous blood is more impure, and that it is the immediate recipient of the offending precipitating stuff. The blood that has become arterial has at least gone through an attempt at purification by traversing the lymphatics, liver, and lungs.

Two forms may be distinguished, the one comparatively simple, the other complicated with general toxæmia. The first is not very dangerous; the second is commonly fatal.

Thrombosis is essentially a disease of puerpery. But we have seen a few cases which apparently arose during gestation. In one of these we traced antecedent venectasis, a condition which no doubt favored thrombosis. Cases are cited on p. 648.

Clinical History of Thrombotic Excretory Puerperal Fever.

1. The Simple Form.—The patient may have been going on to all appearance favorably for some days after labor, when, more or less suddenly, fever, attended or preceded by rigors and vomiting, occurs. The tempera-

rises to 100° F., and even to 103° or 104°; the pulse runs up to 120, always at the onset, but soon reaching this point. Perspirations are ı profuse; the respirations rise to 30 or more, and occasionally syncope rs, with intermittent pulse and palpitation. Then, following quickly, e pain is felt in the ham, in the groin, or in the iliac region of one side; leg, usually the left, is found by the patient to be stiff, and to be im-ed in mobility; soon it is seen to be swollen, the swelling beginning in thigh or leg and extending downwards. There is usually hyperæsthesia ne surface. The swelling has other points of peculiarity, distinguishing om the œdema of obstructed veins; it is tense, giving a glistening, shiny, e aspect to the skin—the affection is called by some older authors legmasia *alba* dolens." To the touch the swollen part gives a sense of tance quite different from the doughy feel of œdema; it does not pit er pressure of the finger, but the impression made is quickly removed.

the part is pricked with a needle, instead of serum running off as in ma, a droplet of fluid will start out on the skin, which quickly coagu-. The fluid is charged with coagulable lymph, which the obstructed phatics could not carry off. Pain is evoked on pressure in the groin in the ham; on palpation in the groin and in Scarpa's triangle, the oral vessels are felt as hard cords, and the attendant lymphatic glands felt as knots or lumps, the connective tissue around the vessels being the of coagulated effusion, which has matted all the structures together. e tenderness will commonly be revealed by palpation deep in the iliac on, and occasionally the conditions felt in the femoral vessels may be e out in the iliac vessels. Examined internally, we may also frequently ize the complication with perimetritis, the constituents of the broad liga-t being the seat of inflammatory effusions. In this we see the relation ween the ordinary form of perimetritis and the affection we are now dis-ing. It is to be noted that the perimetric complication often appears a e later.

ı two or three days, for the swelling advances rapidly, the leg becomes pletely powerless. This is partly due to pressure upon the nerves by the sion, and partly to the intrapelvic complication. The leg is usually ucted and turned out; the patient is prostrate, helpless. From time to there is observed in some cases a repetition of the symptoms which ked the invasion of the disease; rigor, vomiting, attack of local pain, ease of fever. These symptoms indicate a fresh entry of noxious stuff the blood. Thus, we have watched a case in which three distinct febrile cks took place at intervals of some days, each attack being quickly fol-ed by evidence of fresh thrombosis in superficial veins of the legs.

he fever and more urgent local signs commonly subside in from seven to days; the limb remains swollen, but is less tense; it may now "pit." re is generally depression for some time longer. Sometimes a measure of ef is attained by the establishment of collateral venous and lymphatic ulation. The swelling gradually subsides; but a degree of paralysis of limb continues for two or three weeks or more.

his simple form is comparatively free from danger. It is an illness of y to fifty days' duration. The absorption of the effused lymph and serum fibrinous deposit takes time. Not seldom, when the leg first seized is ading, the other leg is attacked. Fever ushers in this attack, and the ole history is repeated.

n a remarkable case recorded by Fancourt Barnes,[1] a young lady, after atural labor, had febrile symptoms on the fourth day; attacks of syncope

[1] Brit. Med. Journ., 1879.

followed; on the sixteenth day mania set in; loud bronchitic râles appeared; a thick purulent discharge came from the vagina; on the twenty-third day the left leg began to swell, the mania diminished; on the twenty-eighth the right leg began to swell; on the thirtieth the left arm was swollen, and white like the legs. There was also some stiffness in the right arm, but it did not swell. After the left leg began to swell she had several attacks of cyanosis; her respirations rose to 48, and she died forty days after labor. An autopsy could not be obtained; but it is fair to interpret the phenomena as due to general toxæmia and multiplied thromboses; the lung affection was evidence of the pulmonary infarction of Virchow, capillary embolism. The case has analogies with the cases of phlegmasia dolens occasionally met with in typhoid fever and in cancer.

Dr. Bastian relates a remarkable case of extensive thrombosis. A 2-para had been confined three months. She got up a fortnight after labor. Three weeks later mastitis and abscess appeared. Soon after this the left ankle swelled. The left leg then showed the common phenomena of phlegmasia dolens. The heart sounds were normal, pulse 160, perspirations profuse, no albumen in urine. The temperature rose, and the right foot swelled. Then the left shoulder and left side of the neck became affected. The swelling then extended down the arm and to the fingers. Next, the right side of the neck and right arm swelled; then the whole front of the chest; then the face. She could hardly open her mouth to swallow. The left external jugular vein could be felt like a cord. She gradually recovered under stimulants, beef-tea, and milk.

If, with Simon, we regard fibrin as an excrement, we must conclude that hyperinosis is the result of failure of the excretory function. When there is excess of fibrin, there exists a proclivity to separation of it from the blood-stream. It is liable to be caught and deposited on any points where the general smoothness of the lining membrane is broken—for example, on the valves of the heart and amongst the columnæ carneæ. It is also subject to clot spontaneously wherever the blood-channel is unusually tortuous, where gravitation has to be overcome, where the vessels are exposed to obstruction and the stream is consequently slow. Acute rheumatism—a disease which offers many instructive points of comparison with puerperal fever—is especially prone to precipitate fibrin on the left cardiac valves. The presence of a second morbid material is probably necessary to cause the fibrinous precipitation. The lactic acid of rheumatism may be the efficient cause. This is a form of arterial thrombosis.

Recovery takes place by gradual disintegration of the thrombi in the veins and lymphatics. This process is analogous to that by which the involution of the uterus is effected. The clots undergo granular fatty convesion, forming a kind of emulsion, or as Virchow calls it, "physiological milk." This is carried into the circulation, and is excreted without creating obvious disturbance. The vascular channels are cleared, and resume practical integrity.

Sequelæ. Amongst the most prominent and persistent is venectasis. Veins that have been over-stretched rarely, if ever, quite recover their pristine calibre; and this is more especially the case with superficial veins of the leg. Hence bundles of varicose veins are formed about the legs and thighs. These become the seat of slow thrombi long after labor; the blood retarded in the tortuous vessels, especially near the valves, easily coagulates; varicose ulcers succeed, and sometimes, when these burst, hemorrhage ensues. The deeper vessels, being supported by surrounding structures, more easily recover.

A woman who has had phlegmasia dolens once is not exempt from the affection in subsequent labors. The recovery may be complete.

THE SEVERE FORM.—The type of this is marked dyscrasia. When, in
ts much depressed by previous illness, bearing some diathetic taint,
re reduced by hemorrhage and protracted labor, septic stuff capable of
ng thrombosis in fairly healthy subjects enters the uterine veins and
natics, the attempt to shut out the enemy by clotting does not succeed.
clots formed are soft, imperfect; the phlegmasia and lymphangitis
l; suppuration takes place; abscesses form in the perimetrium or in
e of the femoral and iliac veins; the whole mass of the blood is invaded
urther degraded. In this form the localizing power is lost. The poison
s bounds. It pervades every tissue in the body, and distant suppura-
may occur. It undergoes a change, partly chemical, partly necrotic.
course of these cases, to which the term "suppurative phlebitis and
hangitis" of Cruveilhier would apply, is rapidly fatal. It is seen most
cteristically in lying-in hospitals, or in that most disastrous conjunction,
g-in ward in a general hospital.

e onset of the disease is marked perhaps by shivering, but there is no
ed reaction. The pulse rises to 140, 160, or more, the respirations to
e temperature to 104° F. or 105°. The condition rapidly assumes
naracter called typhoid. The tendency is towards rapid prostration.
ium often attends, and is the forerunner of death. The history, in
resembles that of general septicæmia, which will be described here-

Sometimes the joints are the seat of inflammation, ending in effusions
ous or sanious fluids or pus.

e danger of embolism is very great in this form of disease, in which
is marked blood-dyscrasia. There is a tendency to rapid breaking-
of the clots, without being converted to assimilable "physiological
" Fragments large enough to be arrested in the pulmonary capillaries
be swept to the heart.

hological Anatomy.—In the simple forms, when the opportunity of per-
ng an autopsy arises, the following conditions are found in the affected

The skin is always thickened; the connective tissue is sometimes
indurated, vascular, infiltrated with serum and lymph. The veins are
ally obstructed by clots and inflamed. In the first stage clots alone are
d; there is no inflammation of the coats of the vessels. In more
nced cases, the coats of the veins are thickened, abnormally vascular;
xternal coat adheres to the surrounding connective tissue; the internal
is reddened, often studded with fibrinous deposit. The obstructing
la may now be softened down to a pultaceous mass, often regarded as
ut which is really the result of fatty disintegration. The veins prin-
y affected are the femorals and iliacs, less frequently the uterine,
al, and saphenous. The lymphatics are often enlarged, matted together
ndensed connective tissue. The glands are generally enlarged and
lar. The cellular sheath of the arteries is infiltrated; all the vessels are
tinated by inflammatory lymph.

the cases in which the septic character predominates, the changes are
general and more distinctive. The clots in the veins are more dis-
rated; the presence of pus is more decided in them, and suppuration is
on in the perivascular connective tissue and in the pelvis; pus may be
rated in the intermuscular connective tissue; the muscular fibres are
ed. Peritonitis and metritis are common; there is effusion of serum
us, and feeble adhesions in the peritoneum. There is often metritis;
varies, tubes, and broad ligaments are inflamed, probably exhibiting
ration. The liver, kidneys, and spleen are congested. The thorax
pulmonary pleuritis; sometimes hepatization of the lungs; pericar-

ditis; fibrinous deposits are found in the left heart, perhaps in the pulmonary arteries, with infarction of the smaller branches.

The treatment will depend upan the severity of the case. In all cases the first indication is "rest." The affected limb should be laid on pillows in such a way as to favor gravitation towards the trunk. Thus, the foot should be raised; the whole limb should be wrapped in cotton-wool, and this should be enclosed in oil-silk, so as to prevent contact of air and keep in exuding moisture. In the early stage, when the symptoms are acute, and there is evidence of vital power, we have known six or eight leeches applied to Scarpa's space do marked good. Frictions should be avoided. If the packing do no other good than prevent the nurse from pursuing this favorite but dangerous practice, a great object is attained.

Acupuncture has been tried. We cannot advise it. No diminution of tension is gained by it.

Dr. Crichton, of Tavistock,[1] speaks highly of the value of sulphate of iron as a local application, in the proportion of thirty grains to the ounce of water, as hot as the patient can bear it.

Can anything be done to favor the solution of the thrombi? We may give quinine, digitalis, and aconite to moderate the heart's action. Ammonia is credited with the property of maintaining the fluid state of the blood. In this way, and as a diffusible stimulant with ether, it is useful. Opium often renders great service. Alcohol must be given with discretion; but it can rarely be dispensed with. Should there be tendency to syncope—and this should be looked for—the subcutaneous injection of ether should be resorted to. Indeed, it is wise to have ether and syringe in readiness for the need which may come suddenly.

We should also be prepared for signs of embolism or cardiac thrombosis.

The treatment of the more severe cases in which thrombosis is defective, merges into that of septicæmia.

Ferric perchloride in combination with quinia finds most useful application.

Arterial Thrombosis.—In Simpson's collected works (1856) special attention is drawn to this accident in puerpery. A memoir on the subject by Robert Barnes will be found in the "Obstetrical Transactions" (1863). This deals chiefly with puerperal cases. The writings of Paget, Kirkes, Virchow, Humphrey, Richardson, and Cohn must be referred to for the light which can be thrown upon the puerperal cases by the study of the affection under other circumstances. The puerperal class of cases form but one chapter, although a singularly instructive one, in the history of coagulation of the blood.

The symptoms which announce the disturbance that takes place in the blood are briefly these: At a period more or less closely approaching delivery, the woman is seized with fainting, intense pain in one or more limbs, and arrest of pulsation in them; then follow loss of heat, gangrene, and perhaps death. In all the cases in which this series of events have been observed, which have been subjected to autopsy, clots have been found in the main arteries of the affected limbs.

In another class of cases we witness sudden faintness, irregular action of the heart, distressed breathing, quickly increasing collapse, and mostly rapid death. In these cases it is found that the pulmonic circulation is almost exclusively concerned, and clot-obstructions are discovered in the right heart and pulmonary arteries.

This is a sketch of a case of arterial thrombosis which came under our care. A lady was delivered easily of her fourth child; the placenta came

[1] Brit. Med. Journ., 1871.

way entire, the uterus contracted well. She went on fairly for seven days, milk and lochia setting in. On the seventh day, after a violent altercation with the nurse, she got up in bed, perhaps was chilled. She was seen soon afterwards restless, agitated, hysterical, complaining of severe spasmodic pains in the abdomen, pulse 120. Next day she was relieved; the pulse had fallen to 100. On the morning of the tenth day the pains had increased; there was great tenderness all over the abdomen, especially in the region of the uterus; tympanites. She felt as if a tight cord were drawn around the abdomen; skin moist, warm; dyspnœa. She could move her legs; there was no tenderness in them, or in the neighborhood of the large vessels. On the eleventh day the condition was much the same. On the thirteenth day there was pain in the region of the uterus, in the calf and ankle of the right leg; she suddenly fainted, and on reviving she was seized with the most excruciating pain in the ankle and calf. Pulse 160; great prostration, but the intellect was clear. A few hours later it was found that the leg between calf and ankle was in a state of gangrene. This quickly extended, and in seven hours from the time it was observed she died.

This case is remarkable as arising under purely puerperal conditions. It is probable that the coagulation took place under the influence of emotion. But in other cases the immediate cause was the detachment of emboli from the aortic valves. From an analysis of fifteen cases Robert Barnes found that the cases might be divided into two classes: 1. Those in which rheumatism was an antecedent condition; the valves of the left side of the heart presented wart-like excrescences. These become detached, and, carried to the arteries, form the foci of thrombi. In some cases rheumatism was noted before the pregnancy; in others it arose during the pregnancy.

Of the fifteen cases of arterial thrombosis referred to, five were complicated with antecedent rheumatism. The earliest date of invasion was on the second day; the latest seven weeks. In eight cases the indications of gangrene arose in less than fourteen days. In thirteen, death ensued in from eleven days to three months. In two instances recovery took place.

2. Cases not complicated with rheumatism or previous heart diseases. It is probable that in these the clotting began in the left ventricle.

In connection with thrombosis and embolia of the systemic arterial system it is necessary to study these conditions in the pulmonic circulating system. In some instances the two systems are simultaneously affected. In contrasting the history of the two circulations, one circumstance is particularly striking. The left or systemic heart is especially prone to disease, whilst the right or pulmonic heart is rarely affected. In the case of the general system the disease mostly takes its origin in the heart; in the case of the pulmonic system the disease takes its origin mostly in the peripheral veins or larger trunks, whence clots, being carried to the right ventricle, are transmitted to the pulmonary arteries. In certain conditions, however, as puerperal pneumonia, there is reason to believe that primary coagulation sometimes takes place in the pulmonary arteries and arterioles. Adopting the language of Virchow, we may say that in the system of which the left heart is the centre we have primary central thrombosis and secondary peripheral embolia; and in the system of which the right heart is the centre there is generally primary peripheral thrombosis, secondary cardiac implication, and tertiary embolia of the pulmonary arteries.

It may be inferred from the history of the cases of recovery that a collateral circulation may be established, or that, if gangrene be not averted, the necrosed portion may be thrown off. In two cases amputation was resorted to.

Barker relates a case in which recovery followed arterial thrombosis with-

out gangrene. A primipara had measles three weeks before labor. Twenty-five days after labor she was seized with excruciating pains in the foot and heel. The foot became cold; pulsation ceased in the tibial artery. On the fourth day after the attack a feeble pulsation returned in the artery, and in two weeks the patient had recovered.

The pain in the limbs attacked is a striking phenomenon. In the reports special words are commonly used to denote its intensity. In Robert Barnes's case the poor woman begged to have her leg amputated. Fordyce Barker tells a case in which the patient was constantly reiterating, "Give me something to relieve me or kill me at once." This pain is noted in non-puerperal cases. Gaspard and Cruveilhier record that violent pain constantly attended injection of foreign substances into the arteries, whilst injection into the veins was painless. Pain generally subsided when the mortification appears; and cessation of pulsation in the arterial trunks leading to the affected limb, loss of sensation and heat quickly follow.

Emboli may also be carried to the brain, liver, kidneys, spleen, walls of heart, and the eye. Burrows relates a case (Simpson's works) in which hemiplegia suddenly appeared six weeks after delivery. Abundant vegetations were found on the aortic and mitral valves. The left corpus striatum was reduced to a diffluent pulp, and the branch of the left middle cerebral artery passing to this part was obliterated by a small mass of fibrin. The artery beyond this obstruction was impervious. Barker relates another case: A primipara was taken two days after labor with a chill and febrile symptoms; the catheter was required. Seven days later she seemed convalescent; but on the eleventh day the temperature rose to 105°, the pulse to 124; on the twelfth day aphasia set in. She died the sixteenth day after labor. Autopsy: Left middle cerebral artery contains a firm white clot at its first bifurcation; vegetations on the mitral valves; spleen three times the usual size; wedge-shaped infarction at upper part; artery going to this obstructed by whitish thrombus.

Barker relates another case diagnosed as cerebral embolism which recovered, and a third ending fatally. It is full of interest; want of space forbids transcribing. A small artery leading from the middle cerebral was found obstructed by a reddish-gray coagulum; there was a mass of vegetations on the mitral valves. Barker points out that in cerebral embolism the symptoms of hemiplegia and apoplectic seizure are almost always suddenly developed; whereas in cerebral hemorrhage these symptoms are generally developed more or less slowly—that is, one after another.

Pulmonary Thrombosis or Embolia.—Of fourteen fatal cases, analysis shows that in six there were clots in the peripheral veins, crural, iliac, hypogastric or uterine; and also that signs of phlebitis or of metritis preceded, often by long intervals, the signs of lung-distress. The first or peripheral symptoms arose in from one to three days after labor; the secondary or pulmonic symptoms occurred at various periods, from four to more than twenty days after labor; death occurred in from ten to twenty-eight days after labor. In eight cases the death was more or less sudden; in these it was generally found that not only were the main branches of the pulmonary artery filled with coagula, as well as the smaller ramifications obstructed, but that clots existed in the right heart. In the cases in which death was more gradual the symptoms of pneumonia were developed.

In those cases in which either minute portions of thrombi are taken up from the peripheral veins, or when the septic or ichorous matter is less virulent, no clot may form in the right heart, but minute emboli may be carried into the finer divisions of the pulmonary artery, causing lobular pneumonia, ending in slower death, and even in recovery.

Pure thrombosis of the venous system—that is, uncomplicated with marked blood-dyscrasia or fever—is not often fatal. It can only become dangerous when portions of peripheral clots are carried to the heart.

Diagnosis.—The symptoms briefly summed up are characteristic. They are clearly distinguished from syncope by the terrible dyspnœa and the preservation of consciousness—conditions which are not observed in syncope.

Is the thrombosis in the right heart and pulmonary arteries *always* the result of embolism?—that is, must we postulate, as a necessary antecedent condition, peripheral thrombosis, as in the crural veins, whence emboli are supplied and carried to the right heart? That this is generally true, dissections prove. Another question arises: Is thrombosis in the right heart and pulmonary arteries frequently or ever spontaneous—that is, primary, not being preceded by embolism? This question has been discussed by Playfair. Analyzing twenty-five cases of sudden death after delivery, he stated that "cases of spontaneous thrombosis and embolism might be divided by a clear line of demarcation, depending on the period after delivery at which the fatal result occurred. In seven there was distinct evidence of embolism, and in them death occurred at a remote period after delivery; in none before the nineteenth day." On the other hand, in fifteen cases out of the twenty-five, with one exception, death occurred before the fourteenth day, often on the second or third day. The explanation submitted is that in the embolic cases time is required for the disintegration of the peripheral thrombus which supplies the emboli; whereas, in the so-called spontaneous heart and pulmonic artery thrombosis, the formation of the thrombi corresponds in time, and to a great extent also in cause, to the ordinary peripheral thrombosis. Playfair enforces this hypothesis by citing cases in which signs of pulmonary obstruction showed themselves without proving immediately fatal, and shortly *afterwards* peripheral thrombosis, phlegmasia dolens of one extremity, commenced.

The argument is strong, and is no doubt generally true. Playfair's analysis agrees with that previously made by Robert Barnes. Exception might be taken to the term "spontaneous." The thrombosis is, strictly speaking, not spontaneous in any case. We believe that in all cases the cause of the original or primary thrombosis, whether in the periphery or in the heart or pulmonary arteries, is like in nature. The immediate cause is the invasion of the venous blood by noxious matter. It is in accordance with clinical observation that the vessels most immediately in relation with the source of the offending matter will most frequently be the seat of thrombosis; and according to the views we have stated as to the conservative purpose of thrombosis, the offending matter is thus commonly barred from reaching the heart in any serious quantity. But this conservative attempt is sometimes thwarted. Noxious stuff, whether it be in the form of ichor, septic matter, or possibly minute fragments of half-dissolved thrombi in the uterine sinuses, may run through the hypogastric and iliac veins, reach the heart and pulmonary arteries, and there cause primary thrombosis. When this occurs the issue is commonly so rapidly fatal that there is little or no opportunity of observing the order of events, such as we possess in the case of peripheral thrombosis, where the disease does not involve vital organs or functions. In some cases, however, notably those of pneumonia from infarction, the natural history of primary pulmonic thrombosis may be followed throughout.

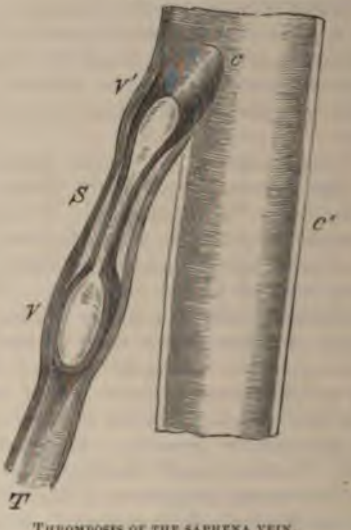
Virchow thus describes lung thrombosis and capillary embolia:

In the pulmonary artery the introduced fragments of thrombi penetrate to different depths according to their size. Usually a fragment sticks fast where a division of the vessels takes place. Very large fragments may block

up trunks of the pulmonary artery, and instantaneous asphyxia ensues; other fragments penetrate into most minute arteries, and there give rise to very minute and sometimes miliary inflammations of the parenchyma; this is *capillary embolia*.

Capillary embolia is also observed in other organs. Thus, endocarditis not seldom forms the starting-point of metastases. Ulceration takes place in one of the valves of the right heart; crumbling fragments of the surface of the valve are borne away by the stream of blood, and are carried to far distant parts. The kind of obstruction which these masses produce is altogether similar to that which the thrombi in the veins give rise to, but they present a different chemical constitution. Their minuteness also and their friability favor their penetration into the smallest vessels; therefore we not unfrequently find an obstructing mass in minute microscopical vessels. This mass constantly presents a finely granular appearance, and does not consist of coarse *débris* such as we find in the veins, but of a very fine yet dense granular matter: chemically, it possesses the property of great resistance to ordinary tests, and so is readily distinguished. This is capillary embolia, properly so called. It frequently gives rise to minute deposits in the kidneys, spleen, and substance of the heart itself; in certain cases it causes sudden occlusion of the vessels of the eye or brain, and, according to circumstances, produces metastatic deposits or sudden functional disturb-

FIG. 164.



THROMBOSIS OF THE SAPHENA VEIN.

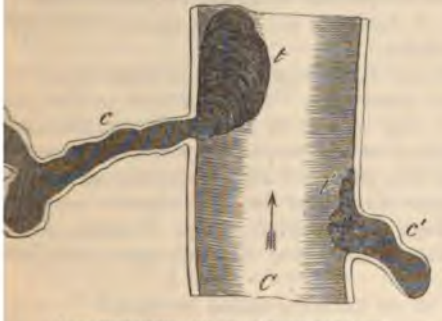
S. The Saphena; T. Thrombus; v v'. Thrombi on valves in process of softening, and connected by thinner and more recent coagulum; c. Prolongation of plug into c' Femoral vein. (After Virchow.)

ances, as amaurosis or apoplexy. This condition is quite distinct from primary arteritis. We must not, however, accept too absolutely the theory of embolism. The contending theory of inflammatory blood demands consideration. Thus, Schroeder contends that embolism does not account for the changes observed after death. In acute fatty degeneration of the liver, parts remain normal; in the case of the spleen, the entire organ is often converted to pulp, but circumscribed morbid foci are sometimes found. In the kidneys also, and heart, muscles, and connective tissue, are circumscribed

flammations, the origin of which cannot be ascribed to embolia. And hen we look at the inflammations of serous membranes, of the arachnoid id joints, which can only be explained by the phlogogenous property of the lood, one cannot doubt that altered blood may cause inflammations without echanical admixture. The history of pulmonary thrombosis from embolism is distinctly traced in the following illustrations from Virchow. ommencing with Fig. 164, we see a thrombus of the saphena vein, one end rojecting into the femoral veins. This thrombus shows two points of softeng or liquefaction into "physiological milk." It is easy to understand how he liquefied portions at *V V* might burst into the femoral vein, and be arried into the circulation in the form of granular embola. Thus we may ave capillary embolism, or the granular matter may be assimilated without erceptible disturbance.

Next, in Fig. 165, we see autochthonous or original thrombi, *c c'*, in varilose lateral branches projecting into the femoral vein *C*; *t* is a prolonged hrombus produced by concentric deposits from the blood; *t'* is a similar hrombus, from which fragments (embola) have been detached and carried to the circulation. The arrow indicates the course of the circulation.

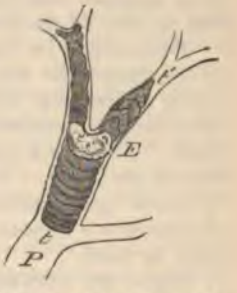
FIG. 165.



AUTOCHTHONOUS AND PROLONGED THROMBI

c', Varicose lateral venous branches, filled with autochous thrombi, and projecting into the femoral vein *c*; rolonged thrombus produced by concentrically apposed sits from the blood; *t'*, Prolonged thrombus from which gments have been detached. (After VIRCHOW.)

FIG. 166.



EMBOLIA OF THE PULMONARY ARTERY.

P, Branch of the pulmonary artery dividing at E, where the embolism is caught and sits astride; *t t'*, the capsulating secondary thrombus. (After VIRCHOW.)

Lastly, in Fig. 166, we see the ultimate stage of embolism producing rombosis in the pulmonary artery. *P* is a moderately large branch of the lmonary artery; *E* is the fork or bifurcation of this artery, upon which e embolon has been caught, and arrested there, blocking more or less cometely the vessel. Secondary thrombi, *t t'*, are found encapsulating the bolon, which has been swept along in the torrent of the venous circulation om *c'*, in Fig. 165.

To show how compensation is effected in lung-obstruction, we cite from aget ("Med.-Chir. Trans.," 1846), who thus explains how the equilibrium tween the systemic and the lung-circulation is disturbed, and how comnsation is sometimes effected: "For the avoidance of either general or lmonary congestion, it is essential that equal quantities of blood shall in given time pass through the systemic and pulmonary circulations respecvely. In the case of an obstruction of the pulmonary arteries of small

extent, the right ventricle will naturally increase the velocity of the blood which it propels through the remaining open arteries; if the quantity thus sent through the lungs be duly kept up, no change will be needed in the systemic circulation. But when many and large branches of the pulmonary artery are obstructed, and the usual quantity of blood cannot be transmitted, then the balance between the two circulations can be maintained and congestion avoided only by the movement of the blood through the systemic vessels being retarded. And this adjustment will be naturally effected—for when the left ventricle receives, through those pulmonary arteries which remain open, a smaller than usual quantity of blood at each dilatation, it must at each contraction discharge an equally small quantity. Hence a diminished velocity of blood through the systemic vessels.

"The peculiarity, therefore, of a person who has a considerable portion of his pulmonary arteries obstructed must be that, in direct proportion to the extent of the obstruction, his systemic circulation is less rapid and his remaining pulmonary circulation more rapid. The patient may thus live for a time without serious discomfort, though with great danger. For if coagulation and obstruction increase, the retardation of the blood in systemic vessels must increase. And this will go on until the blood so nearly ceases to flow in the systemic vessels that the action of the heart and nervous centres are no longer maintained, and thus the patient suddenly or slowly dies. It thus appears that the direct cause of death is not in the state of the lungs, but in that of the brain or of the heart."

Treatment.—In the systemic arterial thromboses there is little experience to stimulate the hope of successful treatment. We must look to the possibility of keeping the patient alive long enough to permit the establishment of collateral circulation, as in aneurism, or to favor separation of the necrosed limb. There is a case of a woman who survived after spontaneous amputation of the limbs. The great principle of rest is of first importance; injections of ether; good nourishment; perhaps free administration of ammonia, on Richardson's hypothesis that fluidity of the blood depends upon alkalinity, may be tried.

Might not intravenous injection of an alkaline saline be tried?

In many cases some mental emotion or sudden exertion has immediately preceded the cardiac and pulmonic distress. The conclusion seems justified that, in some of the cases, the fatal catastrophe might not have occurred had the patient been kept in a condition of mental and bodily repose.

The most hopeful treatment must be sought in prophylaxis: in the earnest study of the causes—remote and immediate. Hence, all that has been said as to the care of the gravida and puerpera is emphasized by the probability of thrombosis if the blood become degraded, and if septic matter get into the veins. During labor care should be taken to insure due and regular contraction of the uterus, avoiding "kneading," which is but another name for bruising. Stimulants, bark, and the mineral acids are, in our experience, the most useful medicines.

In two cases that recovered under our observation we are impressed with the belief that the happy issue was mainly due to the application of leeches over the præcordia. Prompt relief was observed. A small bleeding at the arm may also, by diminishing the flow to the right heart, help to keep the equilibrium between the pulmonic and systemic circulations. There is a natural process of cure if the patient can only be kept alive long enough for this to be carried through. In some cases it has been proved that the obstructing clot had been present for some time before death. As Paget says, citing a case: "A great part of the pulmonary circulation may be arrested in the course of a week without immediate danger to life or any

ication of what has happened." The hope, then, is justified that, under olute rest, sufficient circulation may be kept up to sustain life whilst the is undergoing absorption. But any sudden exertion may at any moment ow upon the damaged circulation a strain too great to bear. Thus, it is ommon history that death has been precipitated by some slight exertion, f sitting up in bed.

UTRID INFECTION.—This is commonly a form of autosepsis, but it may be plicated with exosepsis. It is usually due to the retention in the uterus ome decomposing substance, as a dead fœtus, a mass of placenta, or s. The local signs are masked by the general symptoms. Sometimes e is tympanites of the uterus; physometra. There is rarely any degree nflammation. The condition is essentially empoisonment by the absorp- of foul gases or foul fluids. The empoisonment is sometimes slow and inuous; sometimes rapid, almost sudden. The first thing noticed is the ge in the lochia. For some days the flow may be normal; then it mes less copious, and brownish-black, mixed with more or less sanious *is*. Sometimes hemorrhage of black blood, offensive, and containing of placenta or membranes, occurs. Shivering commonly marks the t, then fever. There is no marked sensibility to touch. Examination show that the uterus is enlarged; the cervix is often gaping; some *is* of clots and offensive discharge come away when the finger is drawn.

igors are often recurrent, followed by renewed febrile movement, so long ffending stuff remains in the uterus to feed the flame. If the offending ter is removed from the uterus, so as to cut off the supply of poison, rovement is sometimes rapid, and recovery is not protracted. But in r cases depression becomes more marked; diarrhœa and sweating per- the pulse and temperature rise; delirium, perhaps coma, precede death. his form of fever has no distinctive morbid anatomy, although in some s, perhaps, those complicated with exosepsis, phlebitis, and metro- tonitis may be observed.

he following is a typical case: A pluripara at the seventh month showed s of the fœtus being dead. We delivered a decomposed fœtus by turn- ; it was with great difficulty that the fœtus was brought away entire. It wed the development of six months; it had probably been dead some ks. The placenta was removed by the midwife. There was no hemor- ge. On the fifth day the patient was reported as suffering from pain in abdomen. On the ninth day the abdomen was excessively distended painful all over; the pulse was small. She died next day. Autopsy: gs generally healthy, save a little chronic tubercular mischief. The ominal cavity was full of purulent fluid; universal peritonitis; liver spleen congested; right kidney completely disorganized, weighing cely an ounce; the left kidney was very large, pale, granular. The ent had not had dropsy or convulsions. The mucous membrane of the nach was intensely congested. The uterus enlarged, covered with recent ph; its substance vascular, but not highly inflamed; its cavity contained e blood, and a small bit of placenta adhered between the openings of the s. The left tube was full of pus.

HYSOMETRA, OR TYMPANITES UTERI.—Under certain conditions the us may become distended with gas or common air. That air may be ted into the uterus when flaccid and the abdominal walls are relaxed, hat the uterus, bagging down, creates a vacuum, is certain. It may also r along with the hand introduced for the removal of placenta or clots. what is understood by physometra is commonly due to putrefactive nges in the uterus, as when fœtus, placenta, or clots are retained. In

some cases the os uteri is occluded by the placenta falling over it; then the imprisoned gases accumulate, the uterus is distended, and it may even give a tympanitic sound on percussion. Commonly, signs of septicæmia, due to absorption of foul gas or fluids from the uterus, attend. Some portion of the gas escaping under the uterine tension, a peculiarly offensive odor is perceived. An offensive vaginal discharge is also frequent. It is developed quickly after labor. There is a sense of tension, simulating pregnancy; uterine colics are common.

Pressure-symptoms, due to the enlarged uterus, become prominent in proportion to the size of the organ; the bladder is liable to compression and paralysis; the breathing is oppressed.

When internal examination is made, the fingers, passing the cervix, feel the occluding mass. The moment this is shifted from the os, fetid gas rushes out, perhaps is heard, is certainly smelt, for the room is quickly filled with an intolerable stench.

Probably, when the uterus has been cleared and washed out with plain water or disinfecting fluid, the septicæmic symptoms will be relieved. But sometimes the empoisonment or other complications are so severe that fever continues and is intensified.

In some cases the tympanites is started during gestation, as when a dead fœtus is retained. Until the uterus is cleared there can be no safety.

When the condition is due to retained fœtus, liquid is commonly added to the gas, constituting *physohydrometra*. Foul discharges of bubbling gas and fluid commonly attend this form.

Becquerel[1] has given a good description of the affection. Staude analyzed[2] 64 cases; of these, 32 died, 18 had severe puerperal complications, and 14 recovered without special disorder.

The dorsal decubitus, the uterus firmly supported by a binder and pad, are important measures in treatment. The general treatment falls within the rules which govern the treatment of puerperal fever.

Course, Characters, and Diagnosis of Pelvic Inflammation.—In the simple traumatic cases, or those in which the septic element is inconsiderable, plastic lymph is rapidly thrown out in the broad ligaments and in Douglas's pouch. The immediate effect is to set the uterus fast. On examination by vagina the uterus is found "set" lower in the pelvis than natural; the vaginal portion is fixed on one or both sides, and generally also behind. This depends upon whether one or both broad ligaments and the retrouterine peritoneum be involved. Sometimes the effusion fixing the uterus so pushes down the fundus of the vagina that the os uteri is flush with the roof of the vagina; but in other cases the effusion causes a circular or half-circular projecting collar round the vaginal portion. These observations establish the diagnosis.

In such a case recovery by resolution may occur. The swelling seems to melt away, but adhesions are apt to be left for some time after.

The onset and progress of the disease are attended by the ordinary symptoms of fever and by pelvic pain. The legs are kept at rest to lessen this pain.

Abscess.—In a large proportion of cases suppuration takes place. McClintock, out of 87 cases, found 37 end in suppuration, with discharge of pus; 24 burst or were opened externally; 6 discharged through the vagina, 5 through the anus, and 2 into the bladder. It is also possible, but very rare, for the abscess to burst into the peritoneum. It is in high degree probable

[1] Maladies de l'utérus, vol. iii

[2] Zeitschrift für Geburtsh. u. Gynäk., Band iii.

that the termination in suppuration is often overlooked. Escape by the vagina or rectum is, in our experience, more common than that noted by McClintock.

If there be septicæmia, if the patient be strumous, or lymphatic, or syphilized, if she be reduced by hemorrhage, the probability of suppuration is vastly increased. The advent of suppuration is commonly marked by recrudescence of fever. Rigor occurs; the pulse is lowered; sometimes vomiting is noted; and when there is septicæmia, the poison, like most others, is carried to the intestines and sets up diarrhœa.

If the abscess be fairly evacuated, spontaneously or by art, a marked amendment takes place quickly. But suppuration may go on for weeks. In some cases only temporary relief is found. The hard tumefaction subsides slowly. Hectic or irritative fever persists. Successive purulent collections may discharge, and it is hard to foretell the end. The patient may sink from exhaustion and chronic pyæmia.

Occasionally the abscess, if formed in Douglas's pouch, may become encysted or isolated by effusions which shut it off from the general peritoneal sac. The imprisoned pus may even undergo a transformation which ends in absorption, and it is converted into a cretaceous mass, which persists, latent or passive, for a long time, and may only be detected long afterwards on post-mortem examination. We have seen such cases. Duncan says he has repeatedly opened latent abscesses.

In some cases, when the bulk of the effusion has melted away, there remain *cellular adhesions*, which may restrain the movements of the uterus, binding it down in various directions. Slowly, perhaps, but pretty surely in the long run, these adhesions disappear. They possess no great vitality. When put upon the stretch, as they are sure to be, under the varying movements of the pelvic organs, their feeble organization is destroyed. We are constantly seeing cases where the patients have assured us on the authority of others that the womb was bound down by adhesions, and where, nevertheless, we find no great difficulty in moving the womb out of the pelvis. The retroflected fundus, enlarged, is simply locked under the sacral promontory.

Another effect of effusion surrounding the uterus is that its due contraction and involution are impeded. The cervix is kept open. Hence the liability to hemorrhage at the time, and to menorrhagia later.

The bladder symptoms are often distressing, but this is not constant. There is dysuria, a frequent call to micturate, and an unsatisfied sense of the bladder not being emptied. This distress is partly due to the interference with the contractile action of the bladder and with the abdomino-pectoral act of expulsion, and partly to the irritating quality of the urine. This is often loaded with lithates and mucus. If an abscess be about to burst into the bladder, the dysuria increases, and commonly there is retention. When the abscess has burst, of course there is pus in the urine. Retention may also precede the bursting of an abscess into the rectum or vagina.

The secretion of milk is generally suspended, either quickly or gradually.

When the condition has become chronic and the patient gets about, she walks with a characteristic limp. The walk is enough to suggest a diagnosis. Sciatica on the side affected is not uncommon.

There are four varieties of peritonitis which in many points resemble puerperal pelvic peritonitis, and which are sometimes associated with it. One is *perityphlitis;* the second is a *localized adhesive peritonitis* occupying one iliac fossa; the third is peritonitis of the lower part of the abdomen from *cancerous affection* of the pelvic organs and lumbar glands; the fourth is *tubercular peritonitis.* The diagnosis from cancerous inflammation or deposit is important to make. A broad distinction lies in the fact that cancer generally

invades the cervix itself, whilst simple inflammation mostly seizes the surrounding tissues.

The question of diagnosis may be appropriately concluded with the caution not to pursue it at the bedside with too much diligence. By repeated and minute examinations it is very easy to do harm. Nothing in the treatment is so necessary as "rest" of the affected parts; and examinations imply disturbance.

The Treatment must vary according to the type of the case and the complications. If the case be one of metritis associated with septicæmia, the treatment of the perimetric inflammation is simply subsidiary to that of the puerperal fever. In the more purely inflammatory cases, leeches to the number of twelve to the groins and hypogastrium will generally be useful in the early stage. Fomentations give some relief. An excellent plan is to smear a bit of lint large enough to cover the hypogastrium with an ointment composed of extract of belladonna one part, mild mercurial ointment three parts, and vaseline six parts; to lay this over the region affected, and over it a layer of absorbent cotton-wool. A few doses of calomel and opium may do good. If diarrhœa ensue, Dover's powder should be resorted to. In ordinary cases salines are useful at first, then opium, digitalis, aconite.

In the more chronic stages blisters are often serviceable. Then quinia or bark or iron come into use.

The question as to opening an abscess is often solved by Nature; but generally it is well to come to her aid by opening it ourselves. The proper time is as soon as fluctuation is made out. The opening should be sufficient to admit a drainage-tube. The walls of the abscess-cavity should, as far as possible, be kept in contact by well-adjusted compresses. If the abscess be opened in the groin, a bistoury is best; if the indication is to open by rectum or vagina, a long trocar is convenient. We have contrived a long tube carrying a knife, which can be projected when the spot to be punctured is reached. This tube can be fitted to an aspirator, and will carry a drainage-tube.

Puerperal Peritonitis, Distinct from Perimetritis; Peritonitic Puerperal Fever.—Peritonitis may be the apparent condition of puerperal fever, or it may be an epiphenomenon or complication of other conditions. As a general rule, inflammation of a serous membrane postulates an already existing morbid affection of the organs invested by the membrane, or toxæmia. A pure "idiopathic" peritonitis is difficult to realize under any circumstances. In a puerpera this is impossible, for her blood, however sound in a theoretical sense, is always in a state of transition, charged with excess of excrement, a condition favorable to the production of inflammation. With this qualification we may accept the term "simple puerperal peritonitis." A puerpera may seem to be progressing favorably for several days after labor, and to have passed the period of danger, when a severe rigor, followed by acute pain in the abdomen and a moderate rise of temperature and pulse and dyspnœa, are observed. These symptoms, however, most frequently occur about the third day, which seems to be the epoch of greatest susceptibility to injurious influences. Frequently, inquiry will elicit the fact that the patient has been exposed to cold, as from getting out of bed. In not a few cases we have been convinced that the exciting cause was the free use of cold water, perhaps ice, to the abdomen, external genitals, and by intrauterine injection to check hemorrhage. This history means checked secretion and excretion—that is, the retention of stuff in the blood that should be excreted. The noxious stuff carried in the circulation acts by predilection upon the tissues which have been recently the seat of intense

physiological energy, perhaps injury. Thus inflammation is apt to be kindled in the peritoneum, although, perhaps, the uterus and perimetric tissues are more commonly attacked first. The attack is almost invariably ushered in by a rigor. Then follows pain, acute, agonizing, referred to the umbilical, hypochondriac, hypogastric, or iliac regions. The whole surface is exquisitely sensitive to touch; the patient shrinks from palpation; even the weight of the bedclothes is distressing. The patient almost invariably lies motionless on her back, the knees drawn up. The pinched, drawn face indicates anxiety and suffering. The pain is usually mitigated after one or two days. But sensitiveness to pressure remains in limited points. This subsides when tympanites sets in and sero-fibrinous exudation takes place. The pulse rises in frequency, to 120 or more; it is hard, but generally becomes feeble when the case is doing badly. The temperature rises to 103°, 104°, or more. The tongue may remain moist and clean throughout, but mostly it becomes coated, yellowish, clammy, and soft, showing the impressions of the teeth. Then, especially in severe cases, the tongue becomes brown and dry, and the teeth are covered with sordes. The appetite is gone, and thirst is distressing. Sometimes hiccough, vomiting, and diarrhœa attend. Hervieux and Barker note the excessive predominance of bile in the evacuations. Tympanites rarely fails; its amount is commonly proportionate to the severity of the disease.

The distention of the abdomen causes or aggravates dyspnœa. In the initial stage of acute inflammation the respiration is short, rapid, thoracic. Later it may become more abdominal, but still it is hurried, as in all cases of fever, keeping relation to the rise of temperature and pulse. The respirations at this stage are 40 to 50 in the minute. In the simpler cases the mind is not much disturbed. Pain and anxiety predominate.

In the more severe cases, in which the toxæmic element is more marked, the preceding symptoms are intensified. The eyes become sunken and surrounded by a dark areola, the cheeks hollow, a hectic spot shows, and the general aspect is darker. The brain becomes oppressed; the expression is dull, or, as Barker says, it is that of absent, dreamy reverie.

Effect upon the Puerperal Functions.—The milk is sometimes, but not always, arrested. We have known it to return after long suspension on recovery. The lochia, in like manner, are not always arrested. When they assume an offensive puriform character, complication with uterine inflammation is indicated.

The duration and issue of the disease depend upon the character of the affection, and the resisting power of the subject. The more simple the inflammation, the greater the prospect of healthy resolution and recovery. In the more simple cases the severity of the symptoms subsides in a few days. But if there be much effusion, especially of a cacoplastic quality, the case is likely to end fatally within a week or fourteen days. Relapses are especially to be apprehended.

In the more severe cases the peritonitis is mostly secondary upon metritis, phlegmasia, lymphangitis, and is an extension from pelvic inflammation. The history of such cases merges in that of these inflammations.

Treatment.—We are here chiefly concerned with the simple forms of peritonitis. The treatment is local and general. The first indication is to relieve pain. This is to be attempted by opium. It must be given freely, on the principle long ago taught by Stokes, and Graves, of Dublin. It is strenuously advocated by Barker as the chief remedy. Opium is the great agent in securing "rest" of the parts inflamed. It quiets peristaltic action, and by allaying pain laps the patient in sleep and tranquility. It must be given boldly and perseveringly. It may be given in the form of pill, a grain every

two hours, or twenty or thirty drops of liquor opii, or solution of morphia, or by subcutaneous injection, and by enema in drachm doses of laudanum, if there is diarrhœa. Barker insists that it may be necessary to continue the use of opium for a week or more; the tolerance of the agent diminishes as the disease recedes. This, he says, is an infallible guide as to the measure in which you can reduce the quantity and diminish the frequency of the dose.

The next indication is to lower vascular tension. The most efficient means of doing this is by bleeding. This remedy is out of fashion; but we are sure we have seen decisive relief from the abstraction of twelve ounces of blood from the arm, and in other cases from twelve to twenty leeches to the abdomen. The cases in which this measure is admissible are those of simple inflammation, and in the earliest stage before effusion takes place.

In the cases now considered, a half-grain dose of calomel every four hours in combination with opium is often of singular efficacy. This is more especially the case when there is accumulation of fecal matter and sluggish liver. When the intestine is loaded, spasm, wind-colic, with tenderness on palpation, or rather the dread of being touched, we have a condition figuratively called "*false peritonitis.*" In this condition there is always some degree of copræmia from the absorption of fecal matter or gases from the intestine. Small doses of calomel frequently bring speedy relief.

Another means of lowering vascular tension is by purging; but this is forbidden by the necessity of keeping the abdomen at rest. And purgatives are out of harmony with opium. We are in the habit of combining digitalis with opium. Barker relies much upon veratrum viride, commencing with five drops of the tincture. It sometimes lowers the pulse in a remarkable manner. Our experience of this is limited, as we have mainly relied upon digitalis, aconite, and bromides. In the complicated forms, quinia must have a prominent place.

The tympanites and diarrhœa are often much relieved by turpentine. This may be administered by enema, in combination with laudanum.

It is also useful in the form of stupes to the abdomen. Flannels are wrung out of hot water and turpentine sprinkled upon them.

Alcohol is of special service in the lower types of the disease, and in the more advanced stages.

A few vaginal and uterine injections of carbolic acid, 1 in 50, at 105° F should be used, so as to obtain the certainty that there is no source of irritation in the uterus. But since this operation involves some disturbance of the patient, it must be practised with all gentleness and skill, and the physician will do well to carry it out himself.

As much nourishment as can fairly be tolerated should be given.

Colpitis puerperalis or *vaginitis* may be mentioned in this connection as an accident of puerpery.

The ordinary form may be nothing more than an excess of the normal hyperæmia attending labor, aggravated by the traumatism of that process. There is intense hyperæmia; rapid shedding of the epithelial layer, sometimes leaving the mucous membrane bare of this element of its structure. This condition is attended by great pain. It is quickly relieved by hot water injections, the efficacy of which is increased by the addition of a little acetate of lead. In other more severe cases, in which the crushing of the vaginal canal under severe labor is great, sloughing may take place, to be followed by granulation and cicatricial atresia.

The vagina may, however, be attacked by erysipelatous, croupous, or diphtheritic inflammation. This may even proceed to gangrene, or, being a local manifestation of a general infection, may end fatally. Thus it is in forms

distinguished by German and Russian physicians, in whose hospitals cases of this nature most commonly occur, as Colpitis traumatica, C. gangrænosa, C. diphtheritica. We have, however, seen the diphtheritic form in private practice.

Metritis.—Beginning with the focus of physiological activity, it may be expected that the organ which is most predisposed to inflammation, which receives the first attack—the uterus—will be the first to suffer from inflammation. This form may be autogenetic or heterogenetic. There can hardly be a doubt but that, in the first instance, inflammation may be concentrated in the uterus. But it rarely stops there. Continuity by vessels, venous and lymphatic, and contiguity of tissues, will rapidly carry the inflammatory process to surrounding parts. Still, it is useful to recognize, if only theoretically, that there is a stage, however short, in which simple metritis may exist. The early suspicion of this stage may dictate treatment at the nick of time when there is the best prospect of limiting the disease.

After-pains give the first warning. Of course, these do not necessarily signify metritis; but if conjoined with febrile symptoms, the diagnosis of metritis receives confirmation. In primiparæ, who suffer comparatively seldom from after-pains, metritis may break out suddenly without warning, in the midst apparently of good health. In multiparæ, on the other hand, after-pains are rarely wanting. They commonly subside spontaneously or under sedatives in from thirty to forty hours; but when inflammatory complication is arising the pains persist and resist all treatment. Then the uterus is heavier, painful on touch, hard, and tense. This condition declares itself on the third or fourth day. Then pain, fever, rigors set in.

The process of involution is arrested. The lochia are usually suppressed. The vagina is felt hot, soft, painful. The uterus is less mobile. There is a sensation of fulness and doughiness in the region of the broad ligaments; touch here brings pain. This signifies that there is already a beginning of peri- and parametritis.

At this point the disease may stop and recovery ensue. But it too commonly spreads, and the case merges into metro-peritonitis or other graver forms.

Then we have the *suppurative metritis*. This is frequently heterogenetic. In this case all the tissues of the uterus are involved. The fever becomes more intense and persists. There is general infection; and, except for the local inflammation, the case can hardly be distinguished from septicæmia. Diarrhœa sets in. Death is not long delayed.

A third form is described by those who have drawn their pictures from observation in hospitals. This is the *gangrenous metritis*. The description is correct. But we think it necessary to point out that the lower segment of the uterus, cervix, and even the vagina, parts which have undergone the bruising of labor, present a rough, dark, even black, soft appearance. This is not gangrene; the condition is superficial, and had probably little to do with the patient's death. In some cases, however, there is true gangrene.

This form is usually marked during life by the intolerable fetor of the discharges. A large ward may be poisoned by them. Prostration is rapid and extreme. The features are sunken and inanimate. There is a tendency to rapid loss of heat. The face, at first pale, becomes patchy, the lips blue, the eyes dull; there is almost constant low delirium; the abdomen is tympanitic, hardly sensitive to pressure; the uterus is very large. Few women recover.

Next comes *puerperal metro-peritonitis*, also frequently heterogenetic. This condition is sometimes no more than an extension of metritis. It usually declares itself early—that is, on the second, third, or fourth day. The

attack is often sudden, or the prodromic stage is so insidious as scarcely to attract attention. It is commonly ushered in by rigor, generally single and lasting half an hour or more, and very severe. Violent febrile reaction follows. Acute pain quickly follows in the abdomen. The pain, although general, is more marked at the sub-umbilical region and in either side of the uterus at the seat of the broad ligaments. The pain is much aggravated by pressure, and is marked by fits of exacerbation. This pain generally subsides in two or three days; but this, unhappily, is no ground for a favorable prognosis. It is rather an indication of advancing depression. Tympanites comes with the pain, due to the accumulation of gas in the paralyzed intestines. Indeed, the outlines of the intestines may sometimes be traced out under the skin. Fever is marked; the pulse and temperature rise. But after a time the temperature often falls remarkably. As Wunderlich remarked, subnormal temperatures are especially frequent in peritonitis, and are always of grave import. Death often happens in this condition. Vomiting and diarrhœa are frequent attendants. Dyspnœa sets in. This is due partly to the tympanites, but frequently pericarditis and pleurisy complicate, and add to the oppression of the lungs. Even pneumonia and small apoplectic effusions occur. The mind is not always greatly disturbed at first, but delirium commonly precedes death. The *facies Hippocratica* is a marked condition.

The milk secretion is arrested; the lochia are commonly suppressed. The involution of the uterus is stopped. Profuse perspirations set in, and sometimes eruptions of sudamina. Often also miliary, pustular, and bulbous eruptions or erythematous patches appear; and occasionally gangrenous eschars are formed on the labia vulvæ and buttocks.

In the more severe cases, such as occur in hospitals, the termination is but too usually in death. In the rare cases of recovery, the inflammation can hardly have been extensive; the disease seems to seek localization in arthritis.

Diffuse inflammation of the connective tissue is not uncommon as one of the issues of puerperal toxæmia. Probably in some cases the form of toxæmia was erysipelas or scarlatina; but in some cases we have been unable to trace this association. Abscesses form in various parts of the body; sloughs may follow, baring the muscles. In some cases sloughs of necrotic kind form on the back and nates. We have found bark, ammonia, quinia, iron, good nutriment effective; and, locally, dressings with carbolized oil have been singularly useful in promoting healthy granulations and healing. A solution of bichloride of mercury, 1 in 2000, is perhaps better. When the skin is unbroken it is the best means of preventing bed-sores. When the toxæmia leads to this peripheral localization there is a fair prospect of recovery; the disease may be regarded as wearing itself out. The indication is to sustain the patient's strength under the trial.

Diffuse Inflammation of the Voluntary Muscles.—In some cases, inflammation of the connective tissue involves inflammation of the muscles. This is seen in the legs and arms. The fine areolar tissue running between the muscular bundles may be the chief seat of the disease, but in some cases, as Virchow has described and figured, the muscular fibres themselves are attacked. They undergo softening, and share in the sphacelus of the connective tissue. Possibly this form of muscular inflammation and softening may be promoted by the chemical changes wrought in the muscles by the intense efforts of labor (see p. 672).

Ophthalmia is observed as a complication of some cases of puerperal fever. The whole globe of the eye is attacked; destructive sloughing takes place. The cases we have seen were traced to scarlatina. But it is probable that

ffection may also arise from erysipelas. It is a complication of bad
It precedes the darkness of death. But we have known recovery,
he loss of sight.

LIARY PUERPERAL FEVER.—The characteristic features of this dis-
are a copious, minute, vesicular eruption, first appearing on the fore-
chest, and arms, and then extending to the whole surface of the body.
esicles are distinct, surrounded at the base by a narrow red circle.
der moderate care and the use of bark and acids the disease is generally
lled.

have seen examples of it. It is undoubtedly an artificially engen-
disease—the result of foul air, excessive heat, bad diet, and the general
t of hygienic rules. It is, we hope, practically banished from this
ry. This disease is liable to be confounded with the scarlatinoid rash
bed further on.

DROSIS OR HIDROTID PUERPERAL FEVER is the name given by Blun-
o indicate a highly dangerous disease, of which the most prominent
om is profuse and distressing perspiration. It is not common; and
present great differences of intensity, from a mild form to extreme
ty ending in death. Ramsbotham describes it with care. He says,
reaks out within four or five days after labor, and is always ushered in
or." Universal diaphoresis breaks out. This brings no relief, but, on
ntrary, a feeling of abject depression; the pulse rises; thirst is dis-
g. The characteristic sign is the peculiar, unpleasant odor from the
it most resembles the smell of newly turned earth. The breath is
and sickly. The milk and lochia are commonly arrested. Diarrhœa
ls. The mental characteristic is irritability. Pain, even on pressure,
marked. In bad cases, vomiting, with hiccough, obstinate diarrhœa,
uick respiration with collapse precede death.

msbotham thought it contagious. In all the cases he saw there had
serious hemorrhage. In some cases he found evidence of metritis, pus
inner coat of the uterine veins; but in others no tissue changes were
ed. Of treatment Ramsbotham speaks sadly. He advised tonics, as
the mineral acids, and good diet. He differentiates hidrosis from
y fever; but it is probable that both diseases arise under similar bad
ry influences. It is one of the puerperal fevers that ought to be
ed out. Both point to the peculiar puerperal constitution, and illus-
the morbific reactions of puerperal blood and autogenetic and hetero-
ic poisons.

The Zymotics in Puerperæ.

the chapter on the "Diseases of the Gravida" the relations of the
tics have been to some extent discussed. We have seen how scarlatina
ts congeners may attack the gravida, how they affect the woman and
etus in utero.

e have now to add a short sketch of the relations to puerpery. These
he most striking examples of heterogenetic fevers. Beginning with
tina, we recall the fact that the infection may be taken before labor or
g labor. And it is extremely important to determine, if possible, when
an. For example, if the poison was taken in before labor, the prob-
y is that it was not communicated by the doctor; if, on the other hand,
ifection dates from labor, it might have been communicated by him or
urse. We have known an action to be brought against the doctor for
unicating scarlatina. It fortunately happened that the infection was
y traced to a source acting before labor. It might be supposed that

the date of infection might be settled by the stage of incubation. But this method, although important, can hardly be applied with sufficient precision. Some hours, a day or more, may elapse before the first distinct outbreak is observed.

In a valuable collection of cases, Dr. Braxton Hicks ("Obst. Trans.," 1871), having grouped eighty-nine cases of puerperal diseases according to the probable causes, found that in thirty-seven the poison was almost certainly scarlatinal. As to incubation, Hicks observed that, although the woman may have been exposed continuously for months before labor, still the disease does not generally manifest itself till the third, fourth, or fifth day after labor. Does the poison lie dormant until labor, when the arterial tension is lowered, and active absorption brings a rush of effete matter into the blood? This speculation is plausible at least.

The peculiar susceptibility of puerperæ to the invasion of scarlatina is shown by the following fact. A doctor who has been in contact with a case of scarlatina may visit in the course of the next day or two twenty or thirty patients, and it is probably only the lying-in woman who takes the disease.

It is sometimes said that scarlatina in a puerpera is scarlatina and nothing more. We have elsewhere pointed out the fallacy of this apophthegm. There is something more, and that is the puerperal constitution. This supplies a special culture-ground—to use a term drawn from the modern doctrine of germs—which modifies the scarlatinal poison, and this in such a manner as to disguise or mask it. Thus, the rash may not be observed—at least, not in its usual characteristic manner. McClintock notes that in several cases the eruption was very rare in showing itself. Sore throat is probably rarely wanting altogether; but McClintock says the affection of the throat was comparatively slight in all the cases; he thinks this exemption is a remarkable feature. Braxton Hicks also found the sore throat slight in all cases. He adds—and we have made the same observation—that the influence of scarlatina may be shown without the rash or sore throat; but its scarlatinal origin may not be indicated by the other usual characters. Glandular enlargements are not constant. Albuminuria is likely to be present; but albuminuria may be due to simple puerperal causes; and unless the urine be drawn by catheter, even this condition may not be detected. Before the stage of desquamation is reached the patient may have succumbed.

It is worthy of consideration whether the scarlatinal poison, working in disordered blood, may not only be itself modified, so that some of its ordinary characteristic phenomena may be changed, and that also some new kind of poison, a venomous *tertium quid*, may be produced. We may see in the clinical history of scarlatina in a puerpera a counterpart of what we see in the history of vaccination. In healthy subjects, vaccination runs a healthy course; but in some unhealthy blood-conditions the zymotic germs run riot, producing the most disastrous consequences, as erysipelas, diffuse cellulitis, and other disorders. So in some healthy puerperæ the scarlatinal poison runs a simple course, all the special phenomena appearing in due order; whilst in other puerperæ the same poison, acting on bad blood, may develop inflammation and suppuration in various parts of the body.

One modifying condition, that may lessen the severity of the disease, is that the subject has had scarlatina before. This probability must be taken into account when discussing the reciprocal influence of scarlatina and puerpery. But the disease may run a fatal course notwithstanding. Whenever there is an epidemic of scarlatina, puerperæ suffer in larger proportion.

As these cases have occurred in simple labor, those who insist upon the traumatic nature of puerperal fevers must attach undue importance to traumatism.

Hicks found these diseases more common in new houses. This is the case also with other zymotics.

If we can prevent scarlet fever only, we shall have diminished the number of puerperal fever cases by at least half; and if attention is paid to clearing the uterus of its offensive contents, we shall avert a considerable number more.

The Severity of Scarlatina in Puerperæ.—Ramsbotham at one time declared that this complication was nearly always fatal; but at a later period, having seen several cases recover, he came to look upon it as less serious. We have seen a fair number of recoveries; but, as a general fact, the complication is more serious than when scarlatina occurs in non-puerperal women. The patient may die before any tissue changes of an inflammatory or suppurative character have been developed. But if she survives some days, and the case does not end in defervescence and cure, the most grave alterations—as peritonitis, synovitis, cellulitis, carditis, pneumonia, pleurisy, ophthalmia proceeding to destruction of the eyeball—may ensue.

McClintock (1866) found in the Dublin Lying-in Hospital a mortality of ten out of thirty-four cases. He observed that the earlier the invasion the greater is the danger.

When the disease runs a favorable course the ordinary functions of puerpery are not interrupted. The milk and lochia continue.

The arguments stated in respect to scarlatina apply to the other zymotics. One common property they possess is that from which their generic name is derived. The zymotic poisons have active, self-reproductive, and infective energies; hence one infection or dose is enough. This constitutes a broad distinction between the zymotics and the autogenetic toxæmiæ. These latter are not reproductive.

Treatment.—Bark, hydrochloric acid with chlorate of potash, stimulants and good nutriment, with frequent warm ablutions, constitute the treatment we have found most efficient.

We have seen cases of *scarlatinoid rash* breaking out in puerperæ, that seemed to be analogous to the similar eruptions observed in surgical patients by Paget and others. It is obviously difficult to differentiate them from scarlatina in the lighter forms, and from erysipelas. Hervieux, in a discussion on this subject,[1] said that he had seen twenty cases at the Maternité; all recovered; in some the eruption was very vivid. There was usually intense fever; the eruption appeared first on the forepart of the trunk, spread to the thighs, then to the upper part of the trunk, did not attack the face, and was not attended by a miliary eruption as is so frequently the case with scarlatina.

Erysipelas.—The complication with erysipelas has often been noted, so that some physicians of limited experience in obstetrics have imagined that they discovered in erysipelas the essential cause of puerperal fever. They have even declared that puerperal fever is erysipelas. Gull ("Med. Gazette," 1849) said: "There is a close alliance between erysipelas and puerperal fever." He examined three cases anatomically, and found in all pus in the veins—not in the veins or sinuses at the seat of the placenta; these were filled with sound, healthy coagula—but in all three the veins about the neck had suppurated. He likens this to the origin of erysipelas in surgical patients. This escape of the body of the uterus and the seizure of the surrounding structures has been noted by Hulme and others. It is especially apt to occur in hospitals. But we have seen it amongst the patients of the

[1] "De certaines éruptions dites miliaires ou scarlatiniformes des femmes en couches, ou de la scarlatinoïde puerpérale, 1862." L'Union Méd., 1863.

Royal Maternity Charity who are delivered at their own homes. In one case, erysipelas appeared the day after labor on the face; both cheeks were distended on the sixth day; a large bleb came on the left cheek; there was great depression, high fever, but the milk was not stopped. She had bark and ammonia, and recovered.

In another case, that of a woman in her thirteenth labor, with twins, both born alive, shivering appeared on the fourth day; on the fifth day erysipelas broke out on the face, the lochia and milk were checked; on the eleventh day the erysipelas had spread, shivering and diarrhœa set in; on the thirteenth day she took perchloride of iron, and recovered.

It is not always possible to trace how the infection was caught. But we do not believe it arises spontaneously. Thus two women living two miles apart had fatal fever in puerpery; they were attended by different men, both of whom had thirty or forty hours before examined the puerperal sore of a phlegmonous erysipelas. Storrs had a series of eight cases of fever after treating a gangrenous erysipelas.

Erysipelas will, perhaps, account for more epidemics of puerperal fever than any other external poison, scarlatina not excepted. The epidemics described by Armstrong, Hey, and many others ran their course *pari passu* with erysipelas in the town.

Lever adduces remarkable instances of erysipelas causing puerperal fever, and of the puerperal affection reproducing erysipelas in infants and nurses.

Dr. Gordon notes that the two epidemics of erysipelas and puerperal fever began in Aberdeen at the same time, and afterwards kept pace together; they both arrived at their acme together, and they both ceased at the same time. He says, further, that the epidemics he witnessed in Durham and Northumberland closely resembled the epidemics of Aberdeen and Leeds. Hey records that in Leeds erysipelas was epidemic at the same time as puerperal fever. Joseph Clarke says the epidemic which visited Dublin in 1767 was like that described in London by Hulme.

DIPHTHERIA in puerperæ is not, in our experience, frequent in home-practice. We have seen a few cases in which diphtheritic exudations appeared on the perineal wound and in the vagina, attended by severe fever. Hicks notes seven cases. "It may produce," he says, "only the symptoms peculiar to itself, or it may be accompanied by secondary local and general lesions." Diphtheria occupies a more important place in the hospital epidemics of Germany.

TYPHOID.—We have seen several cases of puerperæ attacked by typhoid. The characteristic rash appeared.

VARIOLA.—For information upon this complication in puerperæ the reader is referred to the chapter on "Diseases of Gestation."

In one case, read by Robert Barnes to the British Medical Association at Dublin, 1867, the rash assumed a purpuric appearance. In that communication the proposition was enunciated that any one of the zymotic poisons, having invaded a pregnant or puerperal woman, has its usual action modified by the special state of the blood attending her condition. This is so true that in many cases the specific zymotic disease is not easily recognized by its peculiar features, and the symptoms resulting from the combination are merged in a state that passes for puerperal fever. In the case of smallpox, it is true, the characteristic eruption commonly shows itself. But the variolous poison, received into blood already altered by the puerperal state, may be the occasion of such reactions in the blood as to produce symptoms widely differing from ordinary smallpox. This purpuric appearance has been noted in other cases of variola in puerperæ.

Modes of Infection.

All the recognized modes of infection ascertained to operate in spreading animal poisons may be traced in the case of the puerpera. She is liable to invasion by the typical zymotics; she is open to their attack by similar routes, and by a special route in addition—that is, by direct inoculation on the parturient canal. It is by this route more especially that the poisons, other than zymotic, effect an entrance. To enumerate the entrances: All the organs of absorption may take in poison, and carry it into the circulation. Thus, the intestinal canal, the lungs, the skin, the connective tissue may let in the enemy. In the puerpera there is also the parturient canal.

No one doubts that the connective tissue and the mucous membrane of the intestinal canal may give entry to animal, as to other poisons. The parturient canal, whether intact or wounded, is a frequent route. But some, including Schroeder, doubt whether the poison can effect an entry by the lungs. Clinical facts lend unanswerable force to the judgment of Tarnier, who says that "the lungs, by their extent, their activity, present favorable conditions for absorption, and that it is often by this route that empoisonment takes place."

The Carriers of the Poison.—The zymotics may be carried in the air, water, and milk supplied to the patient. The air and water become contaminated by emanations and excretions from the subjects of variola, scarlatina, pertussis, rubeola, typhoid, erysipelas, cholera. The poisons of these diseases may also be conveyed by linen, sponges, or other articles contaminated in like manner. Sewage or fecal matter may contaminate both air and water. Cases under our observation have carried the conviction that scarlatina and puerperal fever have been communicated by sewage gases. We may conclude that the scarlatina poison, microbe or other, is cultivated or preserved in the sewage.

Then there is direct inoculation by touch. The obstetrist or nurse, whose hands are tainted, may carry the poison directly into the vagina or uterus, and there it is taken up either through the intact mucous membrane or through a wound. In the latter case the poison is deposited in the connective tissue, an active absorbent and transmitter. In our experience a wound is not necessary. We do not think there is any fallacy in the clinical observations we have made to vitiate the conclusion that the poison has been taken up in consequence of examinations made during the first stage of labor—that is, before any wound was made. Indeed, in a large proportion of cases no entry of the hand, no vaginal examination is made after the head, which makes the wounds, has passed.

It is by touch generally, if not exclusively, that the necrotic or cadaveric poison is communicated. Our knowledge of the nature of the cadaveric poison has been rendered more precise of late years. We do not know if it has been actually isolated and defined. It is enough for our present purpose to know that there is developed in the body shortly after death a poison of peculiar virulence, and capable of transmission by inoculation. The dissecting-room supplies, unhappily, too many illustrations of this.

Ramsbotham says: "I am quite convinced that the contagious properties of puerperal diseases are rendered even more penetrating and subtle after death; and that articles of clothing impregnated with the effluvium arising from opening the body of a woman who has died of a contagious puerperal malady are the surest instruments of its further propagation."

One of the most instructive lessons is that conveyed in the history of the Vienna Lying-in Hospital, in 1846–47, under Semmelweiss. It is related

by him and by Dr. Routh, who observed the facts. It was established that puerperal fever was communicated directly by inoculation from the hands of medical students, who came from the dead-house and from the coroner's court, and, satisfying themselves with simply washing their hands in a little water, made examinations of women about to be delivered. One point Routh vouches was clearly made out—namely, that the disease was not contagious from one person to another, except the discharges were in some manner communicated. Many of the nurses and midwives had children, but not one of these women caught the disease. In the division where the labors were attended by women who had nothing to do with dead bodies the disease did not exist, or the cases were few and far between. After the students washed in a solution of chloride of lime, the mortality in their division fell to the same ratio as in the midwives' division.

It must, however, be borne in mind that severe endemics of puerperal fever have raged in the midwives' division at other times.

But the poison carried from the post-mortem or dissecting-room is not necessarily the cadaveric poison. If the subject of autopsy have died of scarlatina, for example, the scarlatinal poison will be conveyed. Thus, to record one example: A friend performed the autopsy of a woman who had died of scarlatina; two patients whom he delivered soon after both suffered severely from fever, and scarlatina broke out in their households.

The performance of manual obstetric operations has often been followed by puerperal fever. Thus Dr. Hardy, of Paris ("Arch. gén. de Médecine," 1861), said that in the preceding year every case in which turning was practised in the Maternity of St. Louis was followed by fatal metro-peritonitis. And in contrast to this is the immunity of so-called street-labors—that is, of women who were delivered on their way to the hospital. Spaeth, in his report of the epidemic in the Vienna Lying-in Hospital for 1861–62, says that of 90 women delivered in the street and brought to hospital only one took fever, although they were placed between sick puerperæ. That is to say, when puerperal fever rages in a hospital, it is better for an unfortunate woman to be delivered without help in the streets, than according to art under the direction of science.

A mode of convection, a sad example of which came under our observation, deserves to be noted. A lady, living in an isolated house in the country under the best hygienic conditions, was seized with fever five or six days after an easy labor, no internal examination having been made. The doctor, who had seen no zymotic case for months, and spent many hours a day in the saddle, could hardly have been the poison-carrier. Robert Barnes saw her when she was *in extremis*. The nature of the fever was not revealed by any pathognomic sign; but there was no evidence of metro-peritonitis. After her death, her sister, who had been nursing her, went home to London. Soon after, two of this sister's children sickened with scarlatina. It was then discovered that the nurse, without informing the doctor, had brought an infant from the village three miles distant to the lady to draw her breasts. There was scarlatina in the house from which the child was brought. The chain of evidence was complete.

Fever may be propagated to the woman before or after labor by the medium of the husband or other person coming into close relation, the person serving simply as a carrier. We saw a case of puerperal fever in a London suburb, the conditions of which were subjected to careful investigation. The conclusion arrived at by three physicians was that the infection was communicated by the husband, who had been working in the garden, which had been made up of foul rubbish. He himself had felt unwell, but ex-

d no characteristic symptoms. In this case the poison may have been id or scarlatina, but this could not be determined.

isonous air may enter by the skin, by a mucous membrane, or by the g mouths of veins. It may be inhaled or swallowed. Inhalation is ore frequent. But it may get into the uterus. This it may do in the ing ways: Air may run up alongside the hand and arm during version er operations. After the child is born, the woman lying on her side, laxed uterus, not supported by the flaccid abdominal walls, bags down, erineum is then retracted by the hand in order to remove the placenta, ir rushes in. Sometimes the mere prone position, the vulva gaping, is h. Alternate contraction and relaxation of the uterus may pump in air. may also be forced into the uterus during intrauterine injections of

, having effected an entry into the uterus, may work mischief in several The air admitted may be charged with poison from without, and may direct source of poisoning the system. It may enter the open mouths vessels on the placental seat. It may, by a process of endosmosis, through the tissues of the uterus, or be taken up by the connective exposed by a wound of the mucous membrane. This is heterogenetic ing.

air admitted may be in itself innocuous; but, being retained in the , it may favor decomposition of loose blood-clots and placental frag-, and also of thrombi in the uterine sinuses. This is autogenetic ing.

ysometra has been described in a preceding section (see p. 695.)

The Question of Epidemic Puerperal Fever.

t fevers may rage amongst puerperæ, just as the ordinary zymotics, tina, variola, typhoid, are observed to spread in ordinary communities, orious. But it does not follow that the fevers spreading epidemically gst puerperæ belong to the same order as the zymotics. The spread of amongst puerperæ may be explained in several ways: 1. The fever is variola, scarlatina, typhoid, erysipelas, or some true zymotic, seizing puerperæ as it does upon other members of the community. When the case we may expect to find concurrently, fever amongst puerperæ he general community. 2. Fever attacks puerperæ in hospitals to lying-in wards are attached, especially if the medical and nursing es are in common. In such cases the disease is of the same nature; ins with the medical or surgical patients, and is propagated to the eræ, in whom it finds a congenial soil. Erysipelas is the most common e. 3. The fever begins and ends amongst the inmates of a lying-in al. In such a case the disease may be an ordinary zymotic, or it may oison of non-zymotic type, propagated by the medium of touch or in-ion, or as the result of nosocomial malaria.

hospitals it has often been observed that the fever was caught before Thus, Kehrer ("Monatsschr. f. Geburtsk.," 1861) says in his hospital essen the infection was taken before labor. The course observed was lows: During labor the pains were disturbed, ineffective, painful, c, so that medicines or forceps were often necessary. Some hours after , or on the first or second day, a shivering, of variable intensity, set in, ed by dry heat of skin, quickened pulse, acute pains in various parts abdomen, and quick collapse. The eyes were sunken, with a peculiar y appearance; tongue dry; breathing oppressed; constipation, or more

often diarrhœa. Under rapid prostration, death followed in two or three days. On autopsy, more or less exudation was found in the abdomen of serous, sero-purulent nature, sometimes purulent, with many flocculi. The intestines were much distended with foul-smelling gas; the uterus was much distended, lax, contained dark, putrefying blood; in the veins were stellate, pus-like masses; the spleen was mostly soft and swollen. The exudations in the abdomen were not attended by inflammation in the parenchyma of the uterus or of the peritoneum; the latter especially was not reddened, injected, or altered.

How Puerperal Fever is Propagated in Hospitals.—Can a fever be developed under the simple conditions of overcrowding? There is strong evidence to show that it may. Lusk observed that in his hospital febrile outbreaks were quickly arrested by closing tainted wards and transferring the inmates. Edward Rigby checked fever in the General Lying-in Hospital by establishing efficient ventilation.

An argument has been held that the special epidemic character of puerperal fever is proved by the simultaneous prevalence of fever in hospitals and in the surrounding population. There is an obvious fallacy in this. Of course, scarlatina or other zymotic may arise in a town and attack the puerperæ outside and inside the hospitals, or it may be limited to one or other class. Hirsch says that, in 216 epidemics collected by him, only 12 spread over wide tracts of country; 129 were limited to isolated institutions or parts of institutions; 41 extended from hospitals to the town, but in 21 of these only isolated cases occurred in the towns; 34 affected exclusively the private dwellings of a single locality. Hirsch says the contemporaneous prevalence of typhus or scarlatina is purely accidental.

We have analyzed a large number of reports of epidemics of puerperal fever as to this point, and arrived at the same conclusion as Hirsch. But this kind of negation is not enough. The prevalence of a zymotic, as scarlatina, in a town, its lying-in hospitals remaining free, and *vice versâ*, may be explained simply by supposing that the women in the town and in the hospitals have been attended in labor by distinct doctors and nurses, and that no dangerous communication by other means between the two classes of puerperæ existed. On the other hand, instances abound in which fever was propagated from hospital to town, and *vice versâ*, where intercommunication existed. One infective case, either directly imported into the hospital, or started by doctor, nurse, or visitor, or linen, or other means not always traceable, is enough to create an epidemic.

The analogous observations between the spread of fevers amongst puerperæ in lying-in hospitals, and the spread of diseases commonly associated with the idea of hospital malaria, and other special hospital influences, have been much insisted upon in support of the theory that the puerperal fevers are of the same nature as the surgical fevers in general hospitals. The puerpera is likened to a surgical patient. The argument is further enforced by the histories of epidemics in hospitals which admitted both surgical cases and lying-in women. The puerperæ were attacked by diseases, as erysipelas, hospital gangrene, identical with those which affected the patients in the surgical wards. The facts are true; but they do not quite justify the theory constructed upon them, as will be pointed out further on.

Hospital Miasm.—In discussing the question of malaria in hospitals as a cause of fever in puerperæ as well as in surgical patients, it is important to take into account the analyses made of the air and deposits from it in hospital wards. Thus Eiselt discovered pus-cells in the air of an ophthalmic ward. Epithelium-cells are found in all ill-ventilated rooms. Chalvet found, in dust collected in the wards of St. Louis, 36 and 46 per cent. of

ganic matter; it consisted in great measure of epithelium-cells; when ırnt it gave out an odor of horn; when moistened and allowed to decom- ›se it gave out a fetid, putrid smell. He found it collected in the bed- ırtains and on the walls and windows. Parkes made similar observations the air of various barracks and hospitals. In all tainted atmospheres of is kind, it appears that the germs of infusoria abound to a much greater :tent than in pure air. Chalvet found that linen returned from the wash as still tainted with organic detritus. We know that vaccine matter may : preserved on linen threads. Parkes found that there was some relation 'tween the proportion of carbonic acid in the air and the quantity of ganic matter. The smell of organic matter is generally very perceptible ıen the carbonic acid reaches 0.7 per 1000, and is very strong when it ıounts to 1 per 1000.

A putrid emanation acting for a very short time suffices to turn milk, or set up putrefaction in meat. According to Pasteur, different kinds of emical change are brought about by different germs.

Samuelson ("Quarterly Journ. of Sci.," 1864) made observations of like ıd. Examining dust from window-panes in distilled water, he found cerco- nas fusiformis, amœbæ, and other organisms. The atmosphere was the dium through which the germs or spores were conveyed into the distilled ter. He always found that the more freely the water was exposed to the , and the warmer the temperature, the more abundant and diversified re the living types, and the more rapid their development.

Some of the deductions from these facts are obvious. In the face of them l of clinical observation in hospitals, it is absurd to doubt the reality of ial convection of disease. It has been observed that the greatest care in shing the hands may fail; and fevers have been started where no direct culation by hands was possible. The virus may be caught, condensed, in woollen clothes, whence it is given off in aërial form and inspired by the ient, or comes in contact with the traumatic surface of the perineum. is is confirmed by the histories of fevers following in the track of nurses. Charles White says that "the effluvia (from puerperæ suffering from sorption of putrid stuff from the uterus) help to make the air in the bed l in the room more putrid; this air in every act of inspiration is taken o the lungs, and is then again received into the circulation."

Is it not also possible that a doctor or nurse who has been in close attend- ce on women suffering from puerperal fever may become, as it were, urated with the poison, and exhale it by the breath, to the danger of other erperæ with whom they may come in contact? However this may be, we ve had too many sad occasions to see the wives of doctors struck down by erperal fever. We feel very certain that puerperal fever attacks them in ger proportion than it does other women in a corresponding social sphere. There are many examples of the propagation of the poison which has pro- ced fever in a puerpera to infants, nurses, and others coming into close ation with the puerpera. We will cite a few examples only. Hugen- rger relates that "during the raging of puerperal fever in the Midwives' spital at St. Petersburg, the hospital-poison attacked women laboring der uterine disease—servants, pupils, and midwives. In 1852 a woman th chronic uterine catarrh died under plain symptoms of essential puerperal ver, and dissection showed exquisite suppurative metro-peritonitis. In 56 a female attendant in the post-mortem room died of malignant peri- nitis. In 1858 two intern pupils were seized with typhus and peritonitic mptoms, and died. In 1858–9 midwives had protracted erysipelas of the gs. One of these had, at the beginning of her illness, attended a lady in wn, and in all probability occasioned in her fatal pyæmia."

In appreciating cases of non-puerperal women taking disease from puerperæ, we must remember the analogy we have so often insisted upon between menstruation and labor. We think that on no account should a woman do duty in the post-mortem room.

Influence of Puerperal Fever upon New-born Infants.—Hugenberger relates[1] that during 1846, 1848, 1856, 1859, pregnant women who stayed long in hospital brought forth an increased number of dead and putrid children as compared with the average of 15 years. The mean of 15 years and 8210 children was 498, or 6 per cent., putrid children; but in the spring of 1846 it was 10 per cent.; in autumn, 1848, it was 8 per cent.; in winter and spring, 1856, 12 per cent.; and in winter, 1859, 9 per cent. In 1849, 1852, 1854, the proportion was the normal one, and there was the least intensity of puerperal process. 1846, 1848, 1856, 1859, were years of greatest fever-mortality.

The history of mortality amongst live-born children is also instructive. In 1846, during the height of the fever, cases of sudden death of new-born children were frequent, under symptoms of eclampsia and trismus. The children that fell were mostly sound, well-nourished. In this year, also, acute atrophy with jaundice, erratic and phlegmonous erysipelas, and sclerema were not uncommon. In 1856, during January and February alone, 32 cases of malignant ophthalmia appeared; frequent pyæmic exanthemata, gangrenous erysipelas, umbilical phlebitis, and acute exudative peritonitis reigned during the prevalent fevers of the mothers.

Disease may pass from puerperæ to men. In the "Rivista Clinica di Bologna," 1880, in an account of an epidemic of puerperal fever which raged in Pollenza in 1876, it is stated that a man had intercourse with his wife, who had been recently delivered and had fever with rigors. The man had fever and rigors the same evening, and pain in the groin. Soon erysipelas set in on the penis, spreading to the thigh. On the second day the temperature was 40° C.; gangrene appeared on the scrotum, multiple abscesses, hydrothorax followed, and the man died on the seventeenth day.

In some cases it is certain that the disease caught by a man from a puerpera was scarlatina, typhoid, or some ordinary zymotic. A former colleague, Dr. Manson, thus took typhoid from attending a woman suffering from puerperal fever, and died. But in the Italian case the poison would seem to have been directly inoculated on the penis, and the history of the case differs widely from the course of an ordinary zymotic. And it is probable that in cases like Dr. Manson's the typhoid poison is modified or intensified by working in puerperal blood, and so acquiring special virulence. As Arthur Farre put it: "Nor is it quite certain that zymotic or other inoculating poison may not add a new form of sepsis to that which is already in the blood."

Dr. Storr[2] found that in an epidemic of puerperal fever many of the husbands contracted peritonitis.

Puerperal Mortality in Workhouses.—It is instructive to contrast the dangers of lying-in women in hospitals with those in workhouses. Mouat ("Trans. of Intern. Congress," 1881) showed that the mortality was less than in the special lying-in hospitals; that the death-rate from metria alone was less than in the entire population. This comparative immunity is no doubt due to the simpler and more secluded conditions under which women are placed in the workhouses.

Pathological Anatomy.—It would be to affect a refinement and precision of knowledge quite beyond our grasp, to pretend to give a systematic descrip-

[1] Puerperal-Fieber im St. Petersburger Hebammen-Institute, 1862.
[2] Trans. of Prov. Med. Association.

of the lesions encountered in puerperal fevers, assigning definite lesions
lefinite forms of fever, and to associate with them distinctive diagnostic
s.

he best we can do at present is to recognize the fact that most of the
nges observed in the post-mortem room have been met with in connection
almost every variety of puerperal fever. In some cases, indeed, phle-
is the most predominant phenomenon, and this is recognized during
in others, peritonitis is the main condition discovered, and this also
have been recognized during life. But we cannot say that there are
tissue changes that specially characterize the fever due to scarlatina, or
can differentiate a case of autogenetic septicæmia from one of hetero-
tic origin.

e can only formulate the following propositions:

In one group of cases of fever arising from the most varied causes, ter-
ating fatally, we may discover no structural or organic changes. The
ects have died of general toxæmia.

In another group of cases, arising from the same causes as those of the
group, the most extensive tissue and organic changes will be found.

In some cases these changes have taken place rapidly; in others they
been developed at a later period after labor.

he nearest approach to precise attribution of local changes to a particular
of puerperal intoxication is found in the history of phlegmasia dolens
thrombosis and embolia. In these cases we have strong evidence that
disease is of local autogenetic origin. The like proposition may be
med of pelvic cellulitis in the simpler forms.

eyond these conditions, localization can hardly be affirmed. The fact
the most varied pathological conditions may follow upon fevers of
rse origin may receive some light, from the peculiar blood conditions of
pery which underlie all the forms of fever, imparting to all a common
acter, and binding them together in one broad pathological group.

he morbid appearances found after death present remarkable constancy.
e were justified in interpreting this constancy as evidence of oneness of
disease, we might hope to solve the question as to the essentiality of
peral fever. But the study of causes has always been more complex
the study of effects. We may, however, see in this constancy of patho-
al effects, proof that there is one underlying condition that controls all
morbific factors, imparting to the disease, once started, whatever its
in, a peculiar character. That character is the puerperal.

remising these general propositions, we may attempt a sketch of the
ological appearances most commonly found. For convenience we may
in order the changes found in the several tissues and organs. Those
d in phlegmasia dolens and in thrombosis and embolia have been
ribed in the section on those affections.

o organ or tissue in the body is exempt; but in many cases there is
ter concentration of mischief in particular parts. The uterus, being
erally the *fons et origo mali*, may be taken first. This will lead us to
consideration of metritis. Is there a pure and simple metritis? Can we
or imagine a case in which the proper structure of the uterus is alone
med? It seems difficult to imagine a case in which the inflammation
not begin with the uterine vessels, which have to bear the first brunt
he septic or offending matters lying in the uterine cavity. The term
etritis," then, should properly embrace inflammation of all the structures
which the uterus is constituted. In this way we shall get the concrete
of inflammation of the veins or sinuses, of the lymphatics and muscular
e of the uterus. In the middle cases, in which either the poison is less

virulent or its action limited in time, and the resisting quality of the blood is greater, the mischief is chiefly expended upon the vessels, the contiguous muscular tissue being but slightly affected. Such a case would be recognized in life as metritis, or as phlegmasia dolens; or, the vessels and uterus proper escaping serious complication, the inflammation would seize upon the pelvic connective tissue or peritoneum. Cases of this kind often end favorably; and there is little opportunity for observation by dissection.

But in other cases, in which the poison is more virulent or more prolonged in its action, and the patient's constitution less capable of resistance, not only are the phlegmasia and lymphangitis more intense, but the whole uterus, and commonly its adnexa, are involved. Then we get metro-lymphangitis and phlegmasia. This is but too apt to pass into suppuration—the suppurative metritis of Cruveilhier, so well described and figured by him. It is especially apt to occur in lying-in hospitals, where the individual morbid proclivities are acted upon by the accumulation and intensification of morbific influences. In these cases the uterus is found much enlarged; the muscular tissue is red (dark red), softened, friable; abscesses are diffused in the walls; the veins and lymphatics are tracked by irregular swellings distended by pus; the lymphatic glands are swollen, inflamed, and contain pus. By referring to Fig. 54, which represents the gravid uterus turned down so as to show the immense network of lymphatics on its surface, and the associated glands in the lumbar and dorsal region, and imagining the whole system to be involved in inflammation and suppuration, we shall have a pretty accurate idea of the seat and extent of the affection.

When the disease is taking this course, the general symptoms are much more severe than in the first order of cases; the pain may be less, but the fever is more intense. The pulse is commonly over 130, it may run to 150 or more; the temperature rises to 104° or 105°; rigors are repeated; there is rapid and marked prostration; the mental faculties are dulled; the tongue is dry; bilious vomiting, perhaps diarrhœa, sets in. Delirium, coma supervene. The respiration becomes short and difficult. The lochia are generally, but not always, suppressed. Death follows in a few days.

A more serious form still is the *gangrenous metritis*, also and more especially a hospital affection. The gangrene commonly extends to the vagina and vulva. It must not be confounded with the necrosis of tissue caused by severe protracted labor, and direct crushing, or other injury of the parturient canal. In the gangrene of puerperal fever, the labor may have been easy. The tissue changes are the result of general empoisonment, telling first upon the parturient organs, although undoubtedly traumatism may be an important factor. These cases are almost necessarily fatal. But after death it is surprising to find how extensive the loss of tissue sometimes is; the cervix and vagina have literally sloughed or melted away, exposing the promontory of the sacrum.

In the cases of metritis and metro-peritonitis, suppurative inflammation of the Fallopian tubes is frequent. They are filled to distention with pus, making them sinuous with irregular dilatation; attending this we see inflammation and suppuration of the ovary, and irritation of the adjacent peritoneum, or acute pelvi-peritonitis with adhesions, binding the fimbriated end of the tube to the ovary, and occasionally leaving gaps through which pus exudes. These slender purulent adhesions are easily broken down during the examination.

Internal puerperal metritis, whether it arise soon after labor or several weeks later, is never simple. It spreads to the parenchyma, sinuses, lymphatics, and often to the peritoneum, tubes, and ovaries. Since all these structures have recently been the seat of intense physiological activity, and

denly arrested by a traumatic process, and the blood carries an excess of fibrin and is otherwise modified, they are peculiarly susceptible to inflammation. The putridity of the contents of the uterus, phlebitis, lymphangitis, the state of the blood and lymph, which carry septic matter and infectious germs, are the causes of the uterine inflammation, so often quickly followed by multiple metastatic abscesses, general peritonitis, and death. Autopsy of recently delivered women who have died of metro-peritonitis reveals the uterus uncontracted, with flaccid walls, permeated with fluids, pus, or a fibrino-puriform coagulation, more or less filling the venous sinuses. The mucous surface of the uterus exhibits a mulberry color and a pulpy softening of the decidua, or a sanious puriform liquid which has soaked into the softened mucous membrane. At the level of the placental site is seen a quasi-vegetating surface, formed by the projecting cotyledons of the mucous membrane. On the projecting parts small fibrinous clots are often seen. The whole placental disk is soft, pulpy, infiltrated with sanious blood mixed with a fetid puriform fluid. Often all this part is gangrenous, blackish-brown, and if a stream of water be made to drop on it, shreds of the mucous membrane are detached. At other times there is found on this surface a grayish false membrane, which can be detached in shreds, exposing the mucous membrane tinged reddish-brown. This diphtheritic or gangrenous false membrane sometimes extends over the entire inner surface of the uterus. When the liquid obtained by scraping the surface is examined by the microscope, a great number of lymphatic cellules are found. In the deeper layers of the mucous membrane infiltrated with serosity, scraping collects a little liquid which contains lymphatic cells, large cells of connective tissue, swollen and granular-fatty. The neck of the uterus is softened, violet-red, pulpy, also often covered with the same gray pseudo-membranous mortification as that observed in the body of the uterus; under this membrane the tissue is deeply congested. A similar gangrenous lesion often exists in patches on the vaginal mucous membrane and on the vulva.

The cavity of the venous sinuses is free, or contains, as already mentioned, a puriform liquid, or fibrin coagulated, or pulpy and softened, half liquid, mixed with lymphatic cells and endothelial cells, swollen and granular. The walls of these sinuses in the uterine muscular tissue present evident marks of endo- and periphlebitis. The large veins are often filled with pus or fibrin, and the connective tissue of the broad ligaments always contains more or less pus, so that when sections are made of the broad ligaments in a line with the uterus, one always falls upon one or several small purulent foci, situated either in the veins or connective tissue.

The superficial lymphatics of the uterus are sometimes filled with pus, and in all cases the uterine peritoneum is the seat of intense inflammation, with redness, vascularization, formation of false membranes of fibrino-puriform character. The tubes and ovaries, as before described, are attacked in the same manner. Metastatic abscesses are frequently found in the lungs, liver, kidneys, and spleen.

In the metritis which arises some time after labor the phenomena are far less intense. The uterus has contracted, unless it contain large clots or pieces of placenta; the venous plexuses have had time to contract, and the greater part of the decidua has fallen. All the parts of the uterus and its adnexa are less vulnerable. Nevertheless, the metritis is always more intense than when arising independently of gestation; it is often attended by perimetritis—that is, limited to the pelvis. There results a limited peritonitis circumscribed by false membranes containing a collection of pus. At other times there is formed a phlegmon of the cellular tissue of the iliac fossa.

We may add a fact not without interest. In one case of fatal metro-peritonitis which occurred in the Queen Adelaide's Lying-in Hospital—an institution now closed—we found the stomach had been perforated by post-mortem digestion by the gastric juice. The specimen was exhibited to the Pathological Society, and was cited by the late Mr. Grainger.

The most universal condition discovered after death is probably peritonitis. This was the prevailing condition in a century of epidemics analyzed by Churchill—the true form of peritonitis without metritis. His theory was that the essential condition of puerperal fever was inflammation of the omentum.

The condition of the blood itself, so intimately related to the alterations of the tissues and to the effusions, demands more minute investigation. Hulme (1772) states that the blood taken away was generally sizy, with a quantity of yellow serum. He did not remember ever seeing the blood in a dissolved state. Since venesection has been virtually abandoned, the opportunities of examining blood in large samples are rare; but enough for microscopical and chemical examination might be obtained by puncture.

Symptomatology.—It may be premised, as a general proposition, that in the stage of invasion and beginning of the fever no distinctive signs present themselves which enable us to predict the form of the disease or the precise nature of the morbific poison. History may give a clue as to its nature by informing us of the conditions to which the puerpera has been exposed. But history is full of pitfalls.

When the poison has begun to work before labor, one effect is commonly seen in the disturbance of the process of labor. The labor is lingering from the irregularity and feebleness of the pains. The mental and other nervous reactions are dulled. And yet the poison may have provoked the onset of labor before it is due.

When the poison, zymotic or other, is taken in at the time of labor, the symptoms generally show themselves on the third or fourth day. It is about the same time that the symptoms appear in the autogenetic cases. Before the third day there can hardly be much septic stuff in the uterus, and the tide of absorption has not yet set in.

Classification of Symptoms.—In order to appreciate more clearly the significance of the symptoms, we have attempted to classify them.

1. There are first the *signs of invasion*. These are rigors, headache, backache, hysteria, depression, fainting, minor degrees of shock; then a rise of temperature to 101° or 103° F.; rise of pulse to 100, 110, 120; the pulse at first is often wavering or of irregular rhythm; the respirations rise to 25–30. Reflection will show that these symptoms individually and collectively indicate the infliction of an injury telling upon the nervous centres—that is, a form of shock. These are the symptoms which follow upon the ingestion of animal poisons. They are not always equally marked.

There is one sign, the *gravis odor puerperii*, sometimes noticed. But this is by no means constant, and is often present in a striking manner in healthy puerpery. It is associated with the lochia; the diapers used to the genitals are peculiarly nauseous, but the patient also breathes out, and exhales by the skin, the same characteristic odor. It is analogous to the bromo-menstruation described by Dr. Wiltshire.

2. *Signs of reaction or of elimination* follow. These are: tumultuous action of the heart, irregular pulse, vomiting, diarrhœa, sweating, further rise of temperature and pulse, and greater frequency of respirations, 25–35 in the minute; the breathing is sometimes suspirious; often there is delirium, such as attends fever; the patient is easily recalled to ordinary perception when directly called upon, but, left to herself, she may be observed to wander more

or less. The normal secretions, milk and lochia, are commonly partially or wholly suppressed; indeed, the entire glandular system is disordered.

3. *Signs of General Infection Established.*—Rheumatic pains in the joints and limbs; sweating. In severe cases, diffuse cellulitis, inflammation of muscles, abscesses, ophthalmia, jaundice, pleurisy, peritonitis, pericarditis; inflammation and suppuration in the joints; the pulse, temperature, and respirations all rise.

Of course, all these symptoms are not always present in the connection and sequence set forth. But still they generally have the significance assigned to them. There is commonly some overlapping or recurrence of the first group of symptoms with those of the second group. Thus, if the case be one of autogenetic sepsis, as when septic stuff is taken up from the cavity of the uterus, there may be fresh attacks of rigor, headache, depression, syncope, complicating the signs of reaction or of elimination. When this is seen we have nearly sure evidence of renewed or continuous absorption of septic stuff. Each new absorption entails a repetition of the signs of invasion.

General infection is often marked by high fever alone, without the tissue alterations enumerated. But we insist upon the "rheumatic pains," as they are called, as an indication of the system being permeated by the circulating poison and acting upon all the tissues. We have known cases in which these pains were interpreted as acute rheumatism, and the subjects sent to a general hospital under this diagnosis.

Whenever diffuse, or peripheral, pains and stiffness are observed we should be on the alert for swelling, erythematous blush of the skin, and blebs or vesicles on the hands or fingers. These blebs generally show, at first, serum more or less limpid; but this soon becomes turbid. We have seen cases in which the depending part of the bleb was turbid and the upper part clear, as if pus-globules, separating, gravitated.

The Significance of Pain.—A thing never omitted on visiting the puerpera is to feel the abdomen and hypogastrium. In this way pain is elicited if there is inflammation. Pain is a common, but not constant, attendant upon peritonitis. It may be said that pain is especially marked in the more simple and acute forms of peritonitis, and that in cases where peritonitis is secondary upon or complicated with general toxæmia and metritis, the pain is less urgent. Looked at in this light, pain is a favorable sign. It is a source of comfort and hope to the patient to be able to tell her that pain is not the measure of danger. On the other hand, pain, simulating after-pains or uterine spasms or colics, should always arrest attention. It is often the first signal of danger.

Pain, acute, the centre of which is in one side of the pelvis, may indicate perimetritis or thrombosis. The pain along the course of the femoral vessels and in the popliteal space, aggravated by pressure, probably indicates thrombosis or phlegmasia dolens.

Pain in the joints, especially in the shoulders or knees, is often the first warning of septicæmic synovitis or arthritis. This pain is usually attended by stiffness and impaired mobility of the limb. Hence the importance of ascertaining if the puerpera can move her limbs easily.

The signs may further be classed as favorable and unfavorable. The prognosis is favorable when the pulse and temperature fall and become steady, the aspect improves, and when the tongue becomes clean and moist.

The prognosis is unfavorable when the temperature rises to 105° or more; if it falls rapidly; when the pulse runs to 140–160, is small; when the respirations run to 40 and are "catching;" when the aspect is sunken, anxious, clayey or dusky, indicating septicæmic cachexia; when there is delirium, the mouth and tongue covered with sordes; when aphthæ and diphtheritic

patches appear on traumatic surfaces and on the vagina. Another sign of ill-omen is tympanites. It is an indication of lowered nervous force; it is due to paralysis of the muscular coat of the intestines. If this sign and the diarrhœa and vomiting persist, the prognosis must be grave.

The signs of imminent dissolution are a pulse feeble, not easily felt or counted, temperature abnormally high or below 98° F., rapid suspirious respirations, hiccough, delirium of muttering character, catching at the bedclothes, subsultus tendinum, prostration in supine posture.

The special treatment of the several forms of puerperal fever has been considered in connection with their clinical history. It will be useful, nevertheless, to pass in review the principles of treatment, prophylactic and therapeutic, which have a general application.

Prophylactic Treatment. Antiseptic Midwifery.—There is some danger in dwelling overmuch upon so-called "Antiseptic Midwifery." The better and more comprehensive term is "Prophylactic." For the first part of this treatment we refer to the section on the care of the puerpera (p. 464). So far as antiseptic appliances are concerned, they can strictly only be regarded as subsidiary means in the carrying out of the great principle that lies at the bottom of all good obstetric practice, namely, to screen the lying-in woman from those poisons and other noxious influences which threaten her from within and from without.

It is not, therefore, desirable to devote special or separate attention to what, after all, is only a part of a great therapeutical scheme. The essential thing is to take such a large view of the physiological and pathological processes, as will give the right indications to call upon each and all of the therapeutical agents at our command. To fix the mind too intently upon any one of those agents, is to incur the danger of neglecting others, and of losing sight of the principle which ought to guide the application of all, as one force directed to one end.

Having taken account of the poisons which threaten the puerpera, and of the gates by which they may effect an entry, we shall be better able to protect her. Two great objects have to be kept in view: First, to keep all extraneous poisons out. Secondly, if any effect an entry, to counteract their noxious influences. A primary condition essential to the successful attainment of these two objects is to put the system itself in the best position for defence—that is, to secure the efficient working of all the organs concerned in nutrition and excretion. The carrying out of this programme fully is antiseptic midwifery in the broad sense. The adaptation of the Listerian or conventional antiseptic precautions is antiseptic midwifery in the partial and narrow sense.

Unfortunately, the first condition of effective resistance to toxæmia is not always attainable. We must take the puerperal subject as we find her; perhaps with damaged kidneys or liver, deficient in nerve-power, in fibre, and with skin and lungs unequal to the new task thrown upon them.

About the third day is the epoch for the establishment of the absorptive process. The two days following labor are a period of rest. During this time the disintegration of the uterus and other superfluous structures is only beginning. The supply of waste stuff for absorption is scanty. This can hardly be a source of fever. And if there be any blood or other matter in the uterus, it will hardly decompose under two days or more, so as to yield septic stuff for absorption. But on the third day waste stuff is pouring into the blood; decomposition may have begun in the cavity of the uterus, and active absorption finds material to work upon. Thus it is that febrility occurs on the third day.

1. The obvious lesson to be drawn from this history is to begin antiseptic

treatment early. Indeed, it begins with the conduct of the labor. The first great point is to take care that the labor shall not be protracted. We must spare the system the evils of exhaustion of nerve-power, of loading the blood with the waste stuff resulting from severe muscular exertion. By timely aid in delivery we economize strength and diminish the risk of hemorrhage; and thus, having a reserve of nerve-force and unimpaired muscular fibre, we have the most essential conditions for securing firm contraction of the uterus. It must be superfluous to dwell upon a point so universally recognized. The immediate object sought in securing contraction is to obviate hemorrhage. And to obviate hemorrhage is to oppose septicæmia.

Passing by the usual manœuvres exercised in dealing with the placenta, I will only insist upon the utility of the pad and binder. The compression exerted upon the abdomen and pelvis not only tends to provoke uterine contraction, but it counteracts the aspiration of suction force, which tends to draw air, one of the factors of decomposition, into the uterus. It opposes centripetal osmosis. The day after labor it is useful to give an aperient. It commonly happens that, in the effort of defecation, the uterus, compressed, and sharing in the diastaltic expulsive action, expels a clot. It then contracts more effectually. The maintenance of contraction is efficiently aided by oxytocics. It is our custom to give after every labor a mixture of quinine, ergot, and digitalis three times daily, continued for two or three weeks. The effect in contracting the uterus is remarkable. The patient will often say that she feels the womb contract soon after taking a dose. I look upon this measure as foremost in the scheme of antiseptic midwifery. It is shutting the gate in the face of the enemy.

2. The next thing is to *wash out the uterus.* Plain tepid water may serve the purpose, but a solution of carbolic acid, 1 in 50, or corrosive sublimate, 1 in 2000, is better. This should be done once or twice a day from the second day. On the first day, as we have seen, there is little risk of absorption, and it is important to disturb the patient as little as possible. Should there be the slightest rise of temperature and pulse, this intrauterine injection is imperative. Those who have used it can tell of temperature and pulse reduced, rigors and other signs of toxæmia subsiding, after each injection, and ultimately enabling the patient to pull through the most threatening illness. The injection is best done by a gravitation or siphon tube. The uterine tube should be of glass. Thus a gentle, uniform, stream is insured, all jerking propulsions are avoided, and it is easy to exclude air.

The beneficial action of carbolic acid or corrosive sublimate injections is threefold: First, the uterus and passages are washed out; secondly, the lining membrane of the passages is stimulated in a healthy manner, so that it is less favorable to the reproduction of foul stuff; thirdly, some small portion of the carbolic acid or sublimate penetrates the substance of the uterus, and is absorbed into the system, chasing and neutralizing any poison that may have entered. Thus we follow the enemy through the gate which admitted it. The uterus and vagina, whilst serving as a septicode, are also made to serve as a passage for the antidote. This especially applies to iodine, which readily penetrates the uterine wall. We ought not to refer to intrauterine injections to wash away septic stuff without grateful remembrance of Harvey the Immortal, who thus cured a lady in imminent danger of death from septicæmia. It is probable that this practice, although commonly neglected, has never been quite lost sight of. Thus, John Clarke (1793) has the following: "An injection of the decoction of bark into the vagina (and uterus if it be possible) will be found useful, if it be only by washing out any matters that may be there." Still, it is to Braxton Hicks that we are indebted for the revival of the practice. Tarnier extols a solution of bi-

chloride of mercury, 1 in 2000. He found it more effective in destroying bacteria than any other disinfectant. It has been much used in Germany. Thomas adopts it, and quite recently Lister has subjected it to close scientific and clinical testing, and speaks well of it. Dr. Garrigues, from relative observations in the Maternity Hospital at New York of the use of carbolic acid and bichloride of mercury as intrauterine injections, declares that the great superiority of the latter antiseptic is proved. Dr. Hofmeier reports to the "American Journal of Obstetrics" (1884) cases of poisoning from the use of bichloride of mercury, 1–1000. In one case, profuse, partly bloody, diarrhœa ensued. In another case death ensued. The subject was albuminuric, and the kidneys showed marked changes. Schroeder strictly forbids the use of corrosive sublimate when the kidneys are not absolutely sound. Tarnier's formula of 1–2000 is the right one to adopt.

The manipulations necessary for intrauterine injection give valuable information as to the position and other characters of the uterus. A not uncommon cause of retention of discharge is retroflexion or anteflexion. Reduction should, of course, be effected before injecting, and means taken to keep the uterus *in situ* afterwards.

Carbolic solution should be kept in the room. The catheter should be kept in it. The catheters should be made of annealed glass. If sponges are used, they should be kept in the solution; but it is better to exclude them, and use soft tow soaked in the solution, and burn it immediately after use. Instead of diapers, which it has been proved are a frequent source of contamination, as "they come from the wash," but not from purification, some such contrivance as the "ladies' towel" should be used. These consist of light cotton-wool or tow, impregnated with carbolic acid or the sublimated serum of Lister. They are burned after use. We have suggested the construction of a domestic apparatus for disinfecting linen by heat or sulphurous acid, through which all linen should be passed. The physician and the nurse should practise no manipulation without previously washing in carbolic solution, and lubricating the hand with carbolized vaseline, religiously rejecting lard and other animal grease. The chamber utensils should be rinsed with carbolic solution, and a little of the solution always kept in them.

3. Whilst taking care to exclude foul stuff from the genital canal, we must *be careful to exclude foul air from the lungs and skin.* A supply of pure air is an obvious necessity, but too frequently frustrated. When the sun shines, open the window. At night, especially, a fire is often the condition of good ventilation. If an Arnott's valve be adapted, the fire will then draw off the light foul air which rises to the ceiling, insuring a supply of fresh air from below. It is of the utmost importance to guard against chill or any check upon the due action of the skin, lungs, kidneys, and intestinal canal; that is, maintain in due working order the excretory organs.

4. Charles White insisted strongly upon *drainage of the parturient canal.* The patient, he says, should lie very high with her head and shoulders, and should sit up in bed when she takes her food and suckles, and kneel whenever she has occasion to make water. This frequent upright posture is of the utmost consequence. It prevents the lochia from stagnating, the stools and urine from being too long retained, and promotes the contraction of the uterus together with that of the abdominal muscles. But we have seen mischief from micturition in the knee-elbow posture.

Dr. Goodell has also insisted upon this plan. The principle is admirable. There is no doubt that, in the ordinary recumbent posture, blood and discharges are apt to collect in the lax uterus and vagina. Where a woman is strong, and after a few days, this plan may *perhaps*—we emphasize *perhaps*—be adopted without disadvantage; but in the weakly subjects most prone to

septicæmia, especially after hemorrhage, sitting up has been followed by syncope and sudden death. If firm pressure be maintained upon the hypogastrium, and antiseptic irrigations be duly observed, drainage is secured. At the same time, if the bed is properly made, so that the head and shoulders are kept at a slightly higher level than the pelvis, drainage will be fairly accomplished. The dorsal decubitus is more favorable to drainage than the lateral.

5. An effective barrier against the ingestion of noxious stuff from the parturient canal is to *supply the system with healthy nutriment by the stomach.* The more the system is supplied in this way, the less will it absorb from vicious sources. We believe Oldham was one of the first to lead the revolt against the old fashion of starving on gruel during the first week; and Graily Hewitt has ably taken up the cause. But it is easy to err in reaction. During the first two days the system craves rest as well as food. Food that is not easily assimilable is apt to load the stomach, lying undigested or badly digested. Light broth, beef-tea, milk, toast, or eggs, plain or variously combined, are enough for the first two days. Gradually more solid food may be added. Light stimulants are occasionally useful, but, generally, alcohol may be dispensed with.

Closely connected with the care of the puerpera is the personal conduct of the surgeon and the nurse. As to the surgeon, it can hardly be necessary to insist upon the observance of the ordinary rules of cleanliness. We would only add one or two suggestions. Do not unnecessarily prolong the visit to the sick-room; do not perform any of the functions of a nurse. Avoid as much as possible the use of gloves; exposure to the light and air is the best of all disinfectants. Drive in an open carriage or ride; movement through the air not only blows away surface contaminations from the clothes, but it also cleanses the blood, and washes out of the system the impurities inhaled.

Exercise in the open air on leaving the sick-room, by quickening respiration, promotes immediate oxidation of dangerous organic stuff that may have been absorbed.

To deny, as some men have done, the possibility of receiving or communicating zymotic and other poisons by the atmosphere, is to betray narrow experience or a judgment warped by preconceived theories. We ourselves have on several occasions suffered from dysenteric symptoms, the stools giving the characteristic odor and other qualities, from simply visiting dysenteric patients and examining their evacuations. We further entertain the conviction that we have thrown off poison, by brisk exercise in rowing or riding and a dose of quinia, that would otherwise have developed into serious illness. No one at the present day would dissect or attend the post-mortem room, and at the same time engage in obstetric practice. A healthy doctor will be more likely to have healthy patients.

As to the nurse, similar rules should as far as practicable be observed. Taking care that she does not encounter exposure to the risk of infection, she should get a run for at least an hour or two daily in the open air.

Especial care should be taken that she does not, on entering upon duty, come from attendance upon a doubtful case. She ought to bring a clean bill of health in the form of a certificate from her last abode. The most serious danger often lies hidden in her clothes and linen. The same scrupulous care that is exercised as to the linen of the puerpera and child must be extended to the nurse. She should wear light-colored washable cotton dresses.

We may summarize prophylactic midwifery in the following rules:

1. Keep the door shut against the enemy by maintaining contraction of the uterus.

2. Prevent the enemy from forming and collecting by irrigating the parturient canal with antiseptic fluids.

3. Eject the enemy as fast as it effects an entry; that is, keep the excretory organs in activity.

4. Guard the lying-in chamber against the approach of foreign poisons. Admit no visitors. Watch the linen.

5. Fortify the patient against the attack of the enemy, by keeping up due supplies of wholesome food.

6. Exclude all emotional disturbances. Forbid writing letters.

Antiseptic Midwifery in Lying-in Hospitals.

Given fairly healthy subjects, scrupulously guarded in the manner described, women lying-in in their own homes will present but rare examples of fatal septicæmia. But when lying-in women are massed together in one building, the difficulty of safeguarding them is vastly greater. Perils gather around them in an accelerating ratio. If the history of many lying-in hospitals could be fairly written, we should have a terrible record of lives sacrificed to ignorance, to reckless disregard of medical authority, to architectural folly, to maladministration, to scandalous experimentation of fanciful crotchets. Uninformed benevolence, overriding the practical benevolence of science, has always been prolific of disaster. Nowhere can it count more victims than in lying-in hospitals.

In hospitals, septicæmia or other forms of puerperal fever manifest an active tendency to spread. Many of the so-called epidemics of puerperal fever in lying-in hospitals have undoubtedly been examples of the spread of zymotic fevers. But another class of apparent epidemics undoubtedly owe their origin and spread to contamination by what may rightly be called the "puerperal poison," meaning by this the product of decomposition of blood and discharges in the parturient canal. The poison that one puerpera may thus make for herself may be carried to another puerpera, and so on through a ward. The fire quickly spreads when the fuel is at hand.

The first imperative condition for the safety of women in lying-in hospitals is the absolute single authority of the physician. If this be denied him, his duty to humanity and to his profession is to resign. This is the condition upon which he attends a private patient in her own house. It is infinitely more necessary that he should insist upon it when the care of many women in a hospital is thrown upon him.

A leading principle is to assimilate the conditions of each patient in a lying-in hospital as nearly as possible to those of the patient delivered at her own home. Isolate as much as possible. Take all care that any ill that may attack one patient shall be limited to her. Every hospital should have a room for disinfecting linen by heat or sulphurous acid.

A brief account of the scheme of the Paris Maternité devised by Tarnier, and described by him to the Obstetric Section of the International Medical Congress, in London, 1881, will be the best illustration of this principle carried into practice. Tarnier said that in 1856, when he was interne at the Maternité, the mortality was about 5 in 100; this was now reduced to 2 in 100 in the hospital generally, and to 0.75 in 100 in the pavilion he had had constructed a few years ago. The chief point in this pavilion is that each patient has a separate room, entered from the outside, so that a nurse can only pass from one room to another by going outside into the open air. The furniture is all of japanned iron; the floors, walls, and ceilings are of impermeable concrete. The mattresses and pillows are stuffed with oat-chaff, which is burnt after use in every single case. Instead of a mackintosh sheet,

eet of brown paper made impermeable by pitch is used, and this too is nt after use. He has used various antiseptic solutions for the washing of genitals—borax, carbolic acid, sulphurous acid, and bichloride of mer-y. As the result of experience, he concludes that a weak solution of loride of mercury is the most powerful germicide.

he description given by Dr. Fancourt Barnes of the system in force at British Lying-in Hospital is a further practical illustration of the rules ssary to secure safety. Every patient is delivered under the carbolic y. This disinfects nurses and pupils who are assisting, and prevents the ance of germs or foul matter into the genital tract at the moment when distended and lacerated by the passage of the child. All washings, ngings, and examinations are done with carbolic solution. Carbolic y, of 1 in 80, is nearly continuously playing in each ward. To secure raction of the uterus, each patient has a mixture of quinine, ergot, and m three times a day, for the first week. Since instituting the above tice, he rarely finds any rise of temperature during the lying-in.

Ve may thus hope to see the day when women can be delivered in lying-in pitals as safely as in home practice.

he curative treatment is more simple than are the genetic and pathological blems. It may be taken as a general fact that, whatever the form of the r, the principle of treatment is much the same. The first indication is ersevere steadily in the application of the prophylactic measures. In majority of cases these measures are still useful when the fever has ared itself.

he first rule is to isolate the patient as much as possible for her own e, as well as in the interest of others. The next is, when practicable, to re the patient to another room. We have on several occasions seen ked improvement follow this step almost immediately. The positive tment may be studied under three heads: (1) hygienic, topical, opera-, and external; (2) dietetic; (3) medicinal. Following this order gen-ly, we shall find it convenient to consider the special treatment called to relieve particular symptoms or complications.

. *Topical treatment* includes the use of intrauterine injections. Some dis-nination is necessary. If the lochia be offensive, it will generally be icious to wash out the uterine cavity gently twice a day with corrosive limate solution or carbolic acid. If the pulse and temperature fall, and er symptoms improve after an injection, and thus a relapse ensue, it may surmised that the fever is greatly due to renewed supply of noxious stuff. s is an indication to repeat the injection. If, on the other hand, after ing once well washed out the uterus and ascertained that there is no of-ling substance in it, and yet the fever gets worse, it will generally be er not to repeat the injection. The operation can hardly be done with-disturbing the patient. It may, as Braun says, do more harm than l. It is necessary to remember that even injections of plain water may e death. As we have seen, when discussing the use of injections to re-in post-partum hemorrhage, sudden death from shock has occurred. addition of iodine, carbolic acid, or bichloride of mercury to injections inistered in puerpery does not neutralize this danger. Convulsions have owed. Carbolic poisoning has been noted. Fancourt Barnes has noted k urine in several cases in the British Lying-in Hospital, unattended, ever, by any serious symptom. We have also noted iodism following n iodine injections.

' diphtheritic patches be observed on the perineal wound or elsewhere, ting with nitrate of silver is the best plan. We might even inject nitrate ilver in solution, 1 in 10, so as to insure a more complete effect. In the

ordinary case of perineal laceration the wound should be dressed from the time of labor with lint steeped in solution of chloride of zinc.

In the case of peritonitis in the acute stage, if the pulse is good, a dozen leeches will prove useful. Afterwards stupes of hot water, followed by a turpentine stupe, are serviceable. After this the best local treatment is that advised by Dr. de Latour. This consists in exclusion of air from the surface of the abdomen by a layer of collodion and castor-oil, and over this applying a sheet of cotton-wool, or, better, of the disinfected wood-wool. In the simpler acute cases, such as follow upon chill or exposure, the septic element being relatively insignificant, we have seen good effects from applying fifteen to twenty leeches to the abdomen. This is sometimes usefully followed by spreading a layer of mild mercurial ointment with extract of belladonna on lint, and applying this to the abdomen. In all cases the abdomen should be exposed as little as possible.

It is a rule of great practical importance to limit internal examinations as much as possible. Having once ascertained the condition of the uterus as to contraction, position, and emptiness, examinations can do no good, and commonly do harm. Rest of the organs and structures primarily concerned is of the first necessity. The same rule applies to external examinations. Palpation and percussion, gently practised, are necessary to ascertain the condition of the bladder, pelvis, and intestines; but these manipulations should be sparingly practised. The surgeon should especially watch over the bladder, since in addition to the risk of ordinary temporary paralysis, this organ is especially liable to defective action when there is fever or pelvic or abdominal inflammation. Diagnostic exploration can be carried out at the same time as catherization.

The question of how to deal with the breasts arises in this connection. Generally the secretion of milk is soon arrested; the breasts shrink, and seldom demand special attention. We refer to the section on "Mastitis," for specific information.

The treatment of tympanites is partly operative. The distress and danger attending tympanites are due in some measure to the great pressure from distention. This impedes respiration, circulation, and other functions. If the tension could be reduced, corresponding relief might be expected. Braxton Hicks advocated abdominal punctures with this intention ("Obstetrical Transactions," 1868–9), and related cases in illustration. A small exploring trocar is the best instrument. By it the intestine is pierced in three or four of the most prominent points. As Hicks says, "The pressure of the gas on the sympathetic ganglia and nerves, and the tension of the tissues which they supply, add much to the collapse and vomiting. The least that can be claimed for the operation is that the last moments of the patient can be rendered comparatively free from suffering." We have adopted the plan and can speak favorably of it. It must never be forgotten that tympanites is not necessarily a fatal symptom; and it may well be that relieving this symptom may conduce to recovery.

Another mode by which relief from tympanites may be obtained is by passing up into the bowel an O'Byrne's tube. Injections of turpentine also are beneficial.

Tapping or abdominal incision has been advocated by Hervieux ("L'Union Médicale," 1864) in some cases of serous and purulent collections in the peritoneum, on the same principle that is recognized in the treatment of pleuritic collections. He prefers the bistoury to the trocar.

Another operative measure is *intravenous injection*. Tyler Smith ("Obst. Trans.," 1870) proposed in extreme cases of collapse to inject into the veins a mixture of one part of liquor ammoniæ to three of water, to the extent of

half a drachm. The case he related in support affords strong evidence of the value of this method.

In the discussion on Smith's case, we submitted that a better fluid than ammonia to inject would be a saline solution like that which Little used in cholera, adding a little ammonia. It deserves consideration whether transfusion of blood might not be useful.

Refrigeration has been strongly advocated by Thomas. It should, he urges, be resorted to early. The method advised is the application of iced water by means of a rubber coil over the entire abdomen. In a communication to the International Medical Congress at Copenhagen, 1884, Professor Vincent, of Lyons, advocated this principle. He contended (1) that the administration of cold baths was practicable in recently delivered women attacked with puerperal fever; that (2) cold baths were free from danger in the puerperal state; (3) they had a certain and quick antifebrile effect in the sequelæ of delivery; (4) recovery from puerperal fever was the rule with treatment by baths of proper temperature and methodically administered; (5) cold baths were indicated in all high-temperature forms of after-complications of childbirth, the very acute peritonitis excepted. The indication for cold baths did not arise except where the fever was kept up, without notable morning remission, to about 40° Cent., when the powerlessness of quinine and diffusible stimulants in full doses had been shown, and when, in fine, the lochia were fetid, and intrauterine injections had been carefully tried without bringing a fall in the febrile condition. (6) Cold baths should be administered at a temperature varying from 28° to 18° Cent.; according to the fall secured by the first bath, given at 28° or 30°, the temperature of the subsequent baths should be reduced. (The rule was, to get with a cold or tepid bath a fall of from one to two degrees of the patient's temperature.) The method used in typhoid fever, treated by cold baths after the system of Dr. Brand, should be followed, with modifications. (7) The cold baths were repeated every three hours until the temperature had fallen to 38°, and stayed there, with only ascending oscillations of some tenths in the evening. (8) When baths of 18° or 20° Cent., repeated every three hours, night and day, did not bring about a notable reduction of temperature, a large ice-bag should be placed, in the intervals of the baths, on the abdomen of the patient. (9) Along with cold baths and ice-bags spirits and tonics should be freely administered; the patients should be fed with liquid or semi-liquid foods. Playfair placed the patient in a water-bed, into which cold water was pumped. Fordyce Barker, speaking from experience, is adverse to the practice. Our own opinion is in accordance with that of Barker.

2. *Dietetic Treatment.*—When fever has set in, the appetite and powers of assimilating nutriment fail. The question of feeding is commonly an anxious one. The plan of giving little and often is the best. The food must be in the liquid form, and not over-concentrated. Milk surpasses everything else, but it is not always tolerated. Beef-tea, freshly prepared, is to be preferred to the numerous extracts so pertinaciously thrust upon us as indispensable and incomparable. Some of these are, however, unquestionably valuable. Thus Brand's and Valentine's essences can often be taken when everything else is rejected; but it will not do lightly to try unknown things under conditions which constitute a dangerous experiment. Specially prepared turtle-soup is an excellent resource.

Injection of food into the rectum when the stomach rebels and the collapse is imminent is a method of great value. The injection should not be bulky. A very useful formula is three ounces of strong beef-tea, one ounce of brandy,

and one drachm of oxide of bismuth. A little laudanum may be added if indicated.

Stimulants, again, require to be given with discretion. Champagne, iced, when the stomach is irritable, is useful. We have known old port prove the best stimulus. Good cognac is the spirit to be preferred. The quantity must be regulated by the indications of the case; Robert Barnes arguing that as at least a portion of the alcohol introduced into the circulation remained unchanged, it would *pro tanto* act as an antiseptic as well as a stimulus.

3. *Medicinal Treatment.*—The great indications are to counteract the poisonous process going on in the system; to aid the excretory process; to allay fever; to mitigate pain; to obviate the tendency to exhaustion. Incidentally, indications arise dictated by complications.

Quinia combined with mineral acids is, if anything deserves the title, our sheet-anchor. It must be given freely in four- or five-grain doses. Various preparations of bark variously combined are occasionally useful. Playfair extols Warburg's tincture, and we can confidently endorse his recommendation.

Of salicylic acid we have not much experience. When we have given it we have been disappointed. The hypophosphites have not given us good results.

Tincture of aconite given in small doses—two drops every hour alone or with quinia—is often efficacious in reducing the pulse and temperature. Fordyce Barker speaks highly of the tincture of veratrum viride used with the same intention. But it is necessary to watch it carefully, and to drop it as soon as the pulse is lowered. We have been in the habit of combining digitalis with quinia. Digitalis is certainly safer than veratrum or aconite.

Sedatives are commonly necessary. Where opium is indicated, laudanum, acetate of morphia, or the sedative liquor, offer the best choice. They are best combined with the quinia and digitalis. Where medicines are not borne by the stomach, an enema containing twenty minims of laudanum with a scruple of chloral hydrate may be tried; a third of a grain of acetate of morphia may be injected hypodermically. Opiates are especially useful in the more acute and simple cases of peritonitis. In the more advanced stages of fever they are not well borne.

Purgatives are rarely indicated. Usually the bowels have been fully relieved before or during labor. And we have advised a gentle aperient of castor-oil tempered with a few drops of laudanum, or a teaspoonful of the compound liquorice-powder, on the second day after labor. When there is suspicion of fecal accumulation or of sluggish liver, half-grain or grain doses of calomel every two or three hours will commonly produce the most satisfactory results. When fever has declared itself, there is commonly a tendency to diarrhœa. It is not desirable to seek to control this at once. But, whether we regard this symptom as an eliminative effort or not, it is certain that when once diarrhœa has set in it is apt to continue as a flux, and help to exhaust the patient. And the drain of fluid from the circulation increases the already too active process of absorption. In most cases, therefore, diarrhœa should be controlled. At first, three-grain doses of gray powder, with an equal quantity of Dover's powder, is the best remedy. Then astringents, as catechu, kino, cusparia, combined generally with opium, may be tried. Bismuth we have not found of much use except in the form of enema. Ferric chloride is sometimes of singular efficacy in the worst cases of fever, attended or not by diarrhœa.

Vomiting frequently attends upon diarrhœa, so that these two symptoms call for simultaneous treatment. The remedies recommended for diarrhœa

are mostly serviceable in moderating vomiting. We have lost faith in hydrocyanic acid; bismuth cannot be trusted. Strychnia, combined with the quinia and digitalis, we have found valuable. A copious draught of hot water has produced an excellent effect; but later, ice alone, or with champagne, is better. If the vomiting merges into the convulsive type, especially with hiccough, the most effective plan is to let the patient breathe four or five drops of nitrite of amyl at long intervals. If the habit of vomiting be interrupted even for a short time, these distressing symptoms are more easily subdued. Cajeput oil, in doses of two or three drops on a lump of sugar, is sometimes useful in these conditions.

Summary of the Discussion of Puerperal Fever.

The following fundamental propositions may be stated:

By the term "puerperal fever" we must understand "fever in a puerpera."

As fevers of various kinds may assail non-puerperal persons, so they may assail puerperæ. We must therefore abandon the vain attempt to find one definite puerperal fever, and we must recognize the clinical truth that there are puerperal fevers.

There is, however, one constant underlying condition of all the puerperal fevers—that is, the puerperal constitution. This puerperal constitution is the soil in which all the disturbing influences work, in which noxious matters, from whatever source, germinate; and which, without always destroying the individual properties of the foreign poisons, imparts to all some common features. It is also highly probable that, under the mutual reactions of ingested poisons and the puerperal constitution, new innominate poisons may be engendered. The puerperal fevers may be classified under the two great divisions of Autogenetic and Heterogenetic.

A. The autogenetic fevers are: 1. The simple excretory puerperal fever, the result of endosepsis, or the arrest of the excretion of waste stuff of involution. This form complicates all other fevers. It is in itself the only true puerperal fever. 2. The fever resulting from absorption of foul stuff from the parturient canal, either from unbroken mucous surface, or by the open mouths of vessels, or from traumatic surfaces; this is autoseptic. This form also is likely to complicate other fevers. 3. This, the proper septicæmia puerperal fever, is revealed under the forms of metritis, peritonitis, pelvic cellulitis, thrombosis, and general toxæmia.

B. The heterogenetic fevers, due to the reception of a poison from without. These may be subdivided into (1) the cadaveric poison, the septic stuff from other puerperæ, animal poisons of obscure origin; and (2) the known zymotic poisons, as smallpox, scarlatina, typhoid, diphtheria, erysipelas.

All the various modes of infection recognized as acting in non-puerperal subjects act in the puerpera. But she is especially open to invasion by direct inoculation of the parturient tract; and empoisonment by the ordinary routes is enormously favored by the peculiar activity of the absorptive function of the puerpera.

Epidemics of puerperal fever have, in many instances, been traced to zymotic influences, especially to scarlatina and erysipelas. Hospital epidemics, especially those not marked by concurrent epidemics in the community outside, are more commonly traced to erysipelas, cadaveric inoculation, and hospital malaria.

Pathological anatomy fails to differentiate the fevers. The most distinctive anatomical changes are those seen in pelvic inflammations and thrombotic fevers. In cases of various origin the anatomical changes may exhibit close similarity. This constancy of pathological effects illustrates the propo-

sition that all the fevers acquire some common character from the underlying puerperal constitution.

In the cases of general toxæmia, the pathological changes are rarely limited to particular organs or tissues. In many cases several organs and tissues are affected. The most common conditions in fatal cases are suppurative peritonitis, uterine phlegmasia and lymphangitis, metastatic abscesses in liver, spleen, kidneys, lungs, and serous inflammations. Less frequent conditions are synovial inflammations, diffuse cellular inflammations, and sloughing, pneumonia, ophthalmia.

The symptoms at the onset of a puerperal fever rarely indicate with precision the source or nature of the fever. Most are ushered in by the common signs of toxæmia. Differentiation, or the identification of the particular poison at work, is established sometimes by watching the clinical evolution of the disease, by the antecedent history, by search into the surrounding influences; and not seldom the problem baffles solution. We must, then, be content with the general fact that we are dealing with a puerperal fever.

The lesson of paramount importance drawn from the history of puerperal fevers is to pursue keenly the study of the causes and the modes of infection. In this study lies the secret of successful prophylaxis. Medical treatment of the severer forms of puerperal fever is proverbially disappointing. But we may hope to stamp them out. It is a case that calls for the widest and the most minute applications of the resources of hygiene.

CHAPTER XXIV.

THE ARMAMENTARIUM OBSTETRICIUM.

It is useful to describe the instruments and other means at our disposal before describing the cases which call for their application.

At the head of all obstetric instruments is the obstetric hand.

The contents of the obstetric bag.

A. Instruments to save the child. Conservative.—1. Lever, superfluous. 2. A long double-curved forceps. 3. Robertson's or other contrivance to return prolapsed funis. 4. Richardson's or Ribemont-Dessaigne's apparatus to restore the child from asphyxia.

B. Instruments to reduce the bulk of the child. Sacrificial.—5. A craniotome or perforator. 6. A crotchet. 7. A craniotomy-forceps or

Fig. 167.

Barnes's Hydrostatic Bags and Syringe

cranioclast. 8. A cephalotribe. 9. A strong wire écraseur and embryotomy-scissors. 10. Ramsbotham's or Braun's decapitating hook. 11. A blunt hook slightly flexible.

C. For Cæsarean section and restoring perineum.—12. Bistoury, director and scissors for laparotomy; sutures; ligatures; needles; needle-holder; artery-forceps. For Porro's operation: Koeberlé's serre-nœud, Cintrat's ligateur, or an elastic band. Sydney Jones's ovariotomy clamp-forceps to seize the bleeding edges of the uterine wound.

D. To induce or accelerate labor.—13. A blunt-ended straight bistoury to incise the cervix in cases of occlusion, extreme contraction, or cicatrization. 14. A Higginson's syringe with a flexible uterine tube nine inches long, or, better, a grooved glass tube on Neugebauer's model, for injecting hot or cold water or styptics, or for antiseptic irrigation. This also serves to expand, 15, a set of Barnes's hydrostatic dilators. 16. Three or four male elastic bougies, Nos. 8 and 9. 17. A flexible male catheter or a glass catheter. 18. A porcupine quill to rupture membranes is useful. 19. Scissors and thread.

E. To restore the mother.—20. A hypodermic syringe to hold 60 m. 21. A transfusion apparatus.

F. Medicines.—22. Chloroform or ether for anæsthesia. Ether for subcutaneous injection. 23. Chloral. 24. Laudanum. 25. Nitrite of amyl. 26. Nitro-glycerine; some may be carried in Martindale's capsules. 27. Ergot of rye. 28. Perchloride or persulphate of iron. Tincture of iodine. 29. Carbolic acid. A solution of mercuric chloride of definite strength, 1 in 20, so that by adding 100 parts of water we get a solution of 1 in 2000 for use. 30. Vaseline with carbolic acid, 1 in 20, or boracic acid. This may be carried in an artist's color tube. Cold cream, lard, oil, may be impure, and should be rigorously discarded.

We may now consider briefly what are

The Essentials of Effective Instruments.

The Forceps.—A true long forceps is one which, whilst seizing the head at the pelvic brim, has its lock and handles clear outside the vulva. The model in most general use is probably Barnes's. This has a moderate head-curve, a moderate pelvic curve, and straight handles. The forceps known as J. Y. Simpson's, still used, is really a short, or at best an intermediate, forceps.

The forceps should be plated with nickel to prevent rust.

The Invention of the Midwifery Forceps.—Dr. Aveling has, in his "Memoirs of the Chamberlen Family," settled this question as nearly as it is possible to do so. In 1869, William Chamberlen and his wife fled, with other Huguenots, from Paris and landed at Southampton. They had two sons—Peter the elder and Peter the younger. Peter the elder, who was born in Paris, there is the strongest circumstantial evidence to make us believe was the inventor of the midwifery forceps. The invention has been very generally attributed to Dr. Peter Chamberlen, the son of Peter the younger, but Dr. Aveling has shown this to be an error. Great confusion has resulted from the fact that the three Peters were all alive at the same time, and two of them were brothers. The instruments used by the Chamberlens are in the possession of the Royal Medical and Chirurgical Society of London.

Since the introduction of the forceps two principal types have ruled, and recently a third type had been added. Each has undergone numerous modifications, more or less important. Indeed, so many have been the inventors of varieties of forceps that Pajot wittily observed "that he does not reproach a man for having invented a forceps, since that might happen to anyone."

Type the First.—The characteristic of this is that it possesses one curve y; the blades are curved to seize the head. The chief feature of this type hat the whole instrument is essentially short, adapted to seize the head en low in the pelvis. It is commonly called "the short forceps." This e prevailed generally in this country until Smellie's time; and, indeed, h rare exceptions, until quite recently.

Type the second is marked by the introduction of the pelvic curve. It is s adapted to follow the curve of the sacrum and the axis of the pelvis to brim. The advantage is enormous, since it admits of seizing the head h in the pelvis and even in the strait. It was introduced in France by ret, in 1747. It has become the classical French forceps. It was oduced in England by Smellie, in 1752, and used by some of his conporaries.

Type the third is distinguished by the introduction of a third curve, the neal.

Hermann, of Berne, added a curve to clear the perineum. This curve is le in the shanks. It does not well admit of axis-traction, the great object he third curve.

The great share in the invention of the modern type of axis-traction ceps must be awarded to Aveling, who exhibited the first true sigmoid

FIG. 168.

AVELING'S SIGMOID AXIS-TRACTION FORCEPS.

ved forceps to the Obstetrical Society on the 4th of March, 1868. This ceps is figured (Fig. 168). The perineal curve is provided in the handles, ich serve for traction.

Tarnier's axis-traction forceps in its first form was made known in 1877. e produced a number of modifications in it before settling the latest—ssibly not to be the last—model (see Fig. 169).

It is distinguished from Aveling's by the perineal curve being provided

with special traction-bars attached to the lower ends of the fenestræ; the handles themselves, having first served to introduce the blades and adjust them to the child's head, thenceforth merely serve as index-needles, showing the progress of the head, by rising upwards towards the abdomen in proportion as the head traverses the pelvis in Carus's curve.

The principles on which a true forceps acts are so important to be rightly understood, that we give Tarnier's illustrations. His argument applies in

FIG. 169.

TARNIER'S AXIS-TRACTION FORCEPS.

fundamental truth to all forceps, but it proves that the great object of axis traction can only be well carried out by the adaptation of the perineal curve. Tarnier claims three distinctive advantages for his instrument:

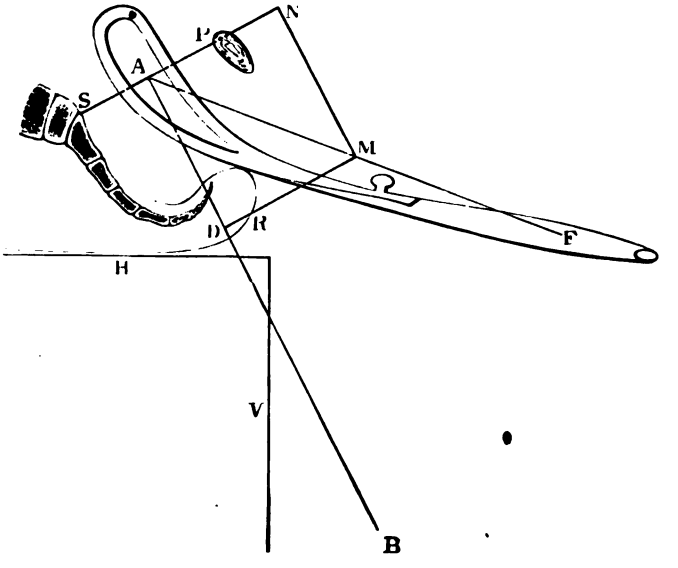
1. It is the best adapted to draw in the pelvic axis. He illustrates this proposition in the following manner (see Fig. 170):

"The figure represents an application of the forceps at the brim. The line A B indicates the axis of the opening which the head must traverse, and, therefore, the direction the tractions must take to be correct. But when the operator pulls upon the handles of the forceps, the tractions he makes are converted into a force represented by the line A F. Supposing that these tractions equal 40 kilogrammes, and that they be represented by the distance A M, and we construct upon this line A M the parallelogram of forces A D M N, we find that the traction A M is decomposed into two forces—the one, A D, which tends to lower the head in the direction of the axis of the brim; the other, A N, representing a vicious pressure which falls upon the pubes. Now, the lines A M, A D, A N present different lengths, which are expressed by the

ımbers 40, 30, 26, in round numbers. Therefore, in pulling upon the ındles of the classical forceps with a force of 40 kilogrammes, one tends to wer the head in the direction A D with a force of 30 kilogrammes only, ıilst involuntarily the pubes is subjected to a vicious pressure of 26 kilo-ammes. It must be understood that in this calculation I have taken into :count simply the forces and the pressures arising out of the act of the)erator, neglecting those which proceed from the natural action of the other's tissues."

He thus demonstrates that it is impossible to pull in the axis of the upper rait or brim, and to avoid vicious pressure by grasping the handle of the 'dinary forceps. Those who object to Tarnier's forceps insist that, by the ell-known manœuvre of pulling on the handles with one hand, and at the

FIG. 170.



TO ILLUSTRATE AXIS-TRACTION. (TARNIER.)

H. V. Horizontal and vertical lines of a table. S. Sacrum. P. Pubes.

me time pushing back upon the shanks with the other, the direction of e traction is changed to that of the axis. We are convinced, from long actice and many close observations, that the correction thus obtained is considerable, and that Tarnier's demonstration is true.

Tarnier next applies a like method of demonstration to the action of the dinary forceps in the cavity and outlet, showing that in these cases also ere is waste of force and vicious pressure. To a less extent than in the se of the brim, his argument is sustained.

2. The traction-force is applied as nearly as possible to the centre of the ild's head. This is a main condition of axis-traction, and it does not im-de the rotation of the head. It insures a great economy of force.

3. An index-needle is provided, which serves to indicate the advance of ıe head, and to guide the direction of the traction-force. This index is nstituted by the handles of the forceps, which rise as the head descends in ıe pelvis, following the curve of Carus.

In his first forceps Tarnier adapted the perineal curve to the handles

themselves as well as to the traction-bars. This rendered the introduction and working of the instrument difficult. It is obvious that, traction being made by the special curved traction-bars, the perineal curve of the handles of the forceps is superfluous. Accordingly Tarnier has abandoned it. His last model has the handles straight, as in the classical forceps. This arrangement makes it more easy to adjust the blades, gives more room for working the traction-bars, and the handles serve as more precise index-needles. We have used this model several times with the greatest satisfaction.

Upon the whole, we think the index-needle principle may be dispensed with. The main advantage of axis-traction can be secured by giving the perineal curve to the handles, which serve for traction. We may trust to the sentient hands to determine the progress and position of the head, and the direction in which traction is to be used.

Many modifications of Tarnier's forceps have been proposed, notably by Lusk and A. R. Simpson.

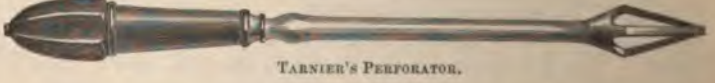
We have used Simpson's, which the Professor lengthened at our suggestion, and find it work well. But we are unable to find any definite improvement upon Tarnier's last model.

We must also notice the two forms of lock which bind the blades of the forceps when adjusted to the head. These are known as the English and the French locks. The first consists in the fitting of one shank into a notch in the other. The French lock consists in a projecting button on one shank, on to which a notch in the shank of the other blades slides. When adjusted, the lock can be fixed by screwing down the button. The French lock has many advantages.

Many ingenious modifications of the forceps have been contrived, under the idea of substituting machinery for the hands to execute the traction and extraction. Pulleys working between the forceps applied to the head and a fixed point outside the body have been the chief means. The force used is regulated by a dynamometer. The contrivances of this order are chiefly associated with the names of Chassagny, Joulin, Pros, Poullet, Tarnier. The force used is for the most part continuous and uniform, not intermittent and variable as when manual force is used. Most of these apparatuses are described and figured by Charpentier. We do not enter upon details concerning them, since they are not likely to come into use. Indeed they have made little way in France. Some objections are obvious: 1. To substitute machines for the hands is to abandon intelligent observation and regulation of the progress of the labor and the forces employed which the hands alone can supply. 2. The blades may slip from the head without warning. 3. The lateral or leverage action which so much economizes traction force and lessens pressure upon the pelvic walls is lost. Experience of deliveries by machinery has not given good results.

THE CRANIOTOME OR PERFORATOR must be straight and powerful. Oldham's is a very efficient instrument. The instruments known as "Smellie's"

FIG. 171.



TARNIER'S PERFORATOR.

and "Naegelé's" are weak and inefficient. All perforators curved in the blades are bad. It is difficult with them to strike the cranium in exact perpendicular, an essential condition to avoid deflection at a tangent, and to prevent the head rolling over under the impact of the instrument.

Fig. 171 is a form of perforator used by Tarnier. It is easier to use when

is movable above the brim than the spear-headed perforator, and a good aperture in the cranial vault.

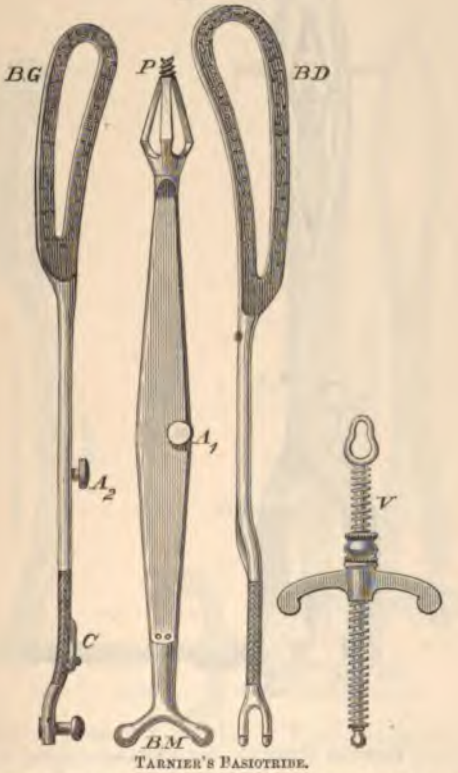
rmany, France, and Italy trepan-perforators have found favor. e tried one of the best, Professor Martin's, of Berlin. The objec- first, that in the most difficult cases the trepan takes up too much be applied accurately; secondly, the opening made by it in the is insufficient, and the vault or arch of the cranium is not suffi-

FIG. 172.

SIMPSON'S BASILYST.

roken up to admit of easy crushing in. Oldham's perforator will n the merest chink, and break up the cranial vault enough for all

FIG. 173.



TARNIER'S PASIOTRIBE.

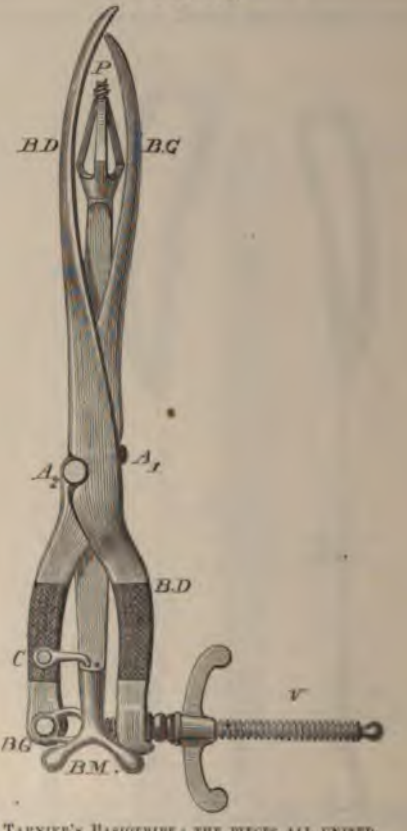
ment is composed of four pieces: 1st, the left blade, *B.G*: 2d, the middle blade, or perforator, e right blade, *B.D*; 4th, the compressing screw, *V*. A_1 and A_2 show the locks. *C* is the catch to t blade to the middle blade.

ost unyielding part of the skull is the base. To break up this nstruments have been contrived. Hubert, in 1860, proposed an ped screw at the point of a long steel rod. This first perforated

the vault, and then was passed on to the base and screwed in at this part. An unfenestrated blade, passed over the head, received its tip, the point of the screw, when this had pierced through the base of the skull. In 1865 Guyon practised intracranial cephalotripsy by means of an instrument consisting of a trephine which perforates the vault, of a second smaller trephine which, guided by a stiletto to the base of the skull, saws out a disk; several disks may be so removed, and then a light cephalotribe crushes in the head easily. This works effectively.

A. R. Simpson's basilyst, as its name implies, is intended specially to break up the base of the skull, and thus more completely to secure reduction of the bulk of the fœtal head. The basilyst is made to perforate the cranial vault, and then to traverse the cranial cavity and perforate the base. As will be seen by comparing the figures, its perforating end is conical and of similar shape to Tarnier's perforator.

Fig. 174.



Tarnier's Basiotribe; the pieces all united.

"The depth to which it can be screwed in is determined by the shoulder, which projects all round the base of the screw; and in a case where a small trepan-like opening is desired, all that the operator has to do is to screw it in up to the shoulder, and then withdraw it. Ordinarily, however, a wider gap is required, and then the operator will compress the handles so as to separate the points and expand the aperture to the requisite extent."

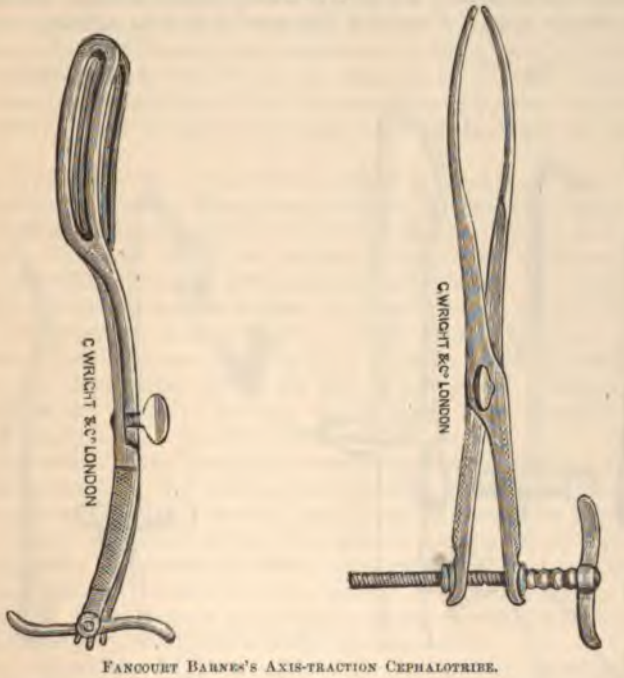
Tarnier's basiotribe is a combination of the perforator with the two blades of the cephalotribe.

The instrument has the following dimensions and weight: The length is 41 centimetres; the breadth from one side to the other, when articulated, is 4 centimetres; the weight is 1200 grammes. The instrument is applied in the following manner: The middle blade is made to perforate the cranial vault, and then held while the smaller or left blade is applied and screwed up on to the middle blade; the right or larger blade is then applied and screwed up on to the other two blades. The instrument is then united as shown in Fig. 174.

The advantages are, that the instrument cannot slip off the fœtal head during the crushing, and that the crushing is much more complete than when done by the ordinary cephalotribe. The overlapping of the right blade, which is the last to be applied, secures thorough crushing of the head and prevents slipping.

THE CRANIOTOMY FORCEPS OR CRANIOCLAST should have the prehensile portion of the blades very slightly curved, duck-billed, and so made as to

FIG. 175.



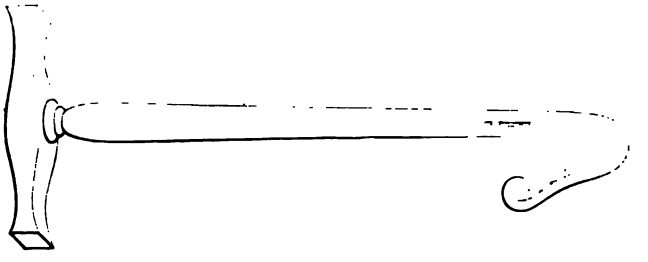
FANCOURT BARNES'S AXIS-TRACTION CEPHALOTRIBE.

grip with the fenestræ perfectly parallel. Thus made, the bone and scalp being seized over a large surface, there is little fear of breaking and tearing away. It must be made of two distinct blades, joined by a French lock after adjustment, and adapted with a compressing screw at the extremity of the handles, so as to save fatigue in compressing and to reserve the operator's strength for traction. Barnes's and Hall Davis's work well. Braun's is too much curved in the blades to take an equally diffused wide grasp.[1]

[1] We think it desirable to make a correction. Charpentier (p. 818) says: "Barnes décrit ainsi son procédé; il se sert du cranioclaste de Braun." There are essential

THE CEPHALOTRIBE.—It should be long enough to seize the head above the brim; stout enough not to "spring" or bend under powerful resistance: slightly incurved at the prehensile end and roughened inside the blades. It should be provided with a compressing screw at the handles to secure the grip.

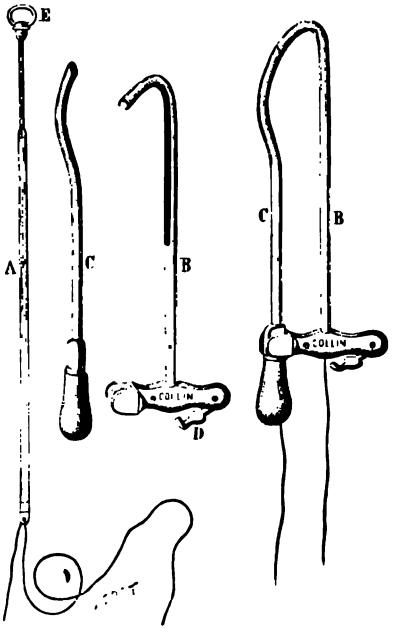
FIG. 176.



BRAUN'S DECAPITATOR.

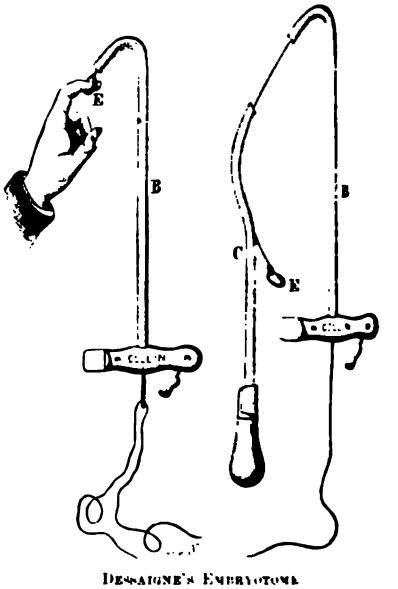
The continental models are mostly unnecessarily bulky. Kidd's model, a straight one, is good. Fancourt Barnes's is a most efficient improvement.

FIG. 177.



DESSAIGNE'S EMBRYOTOME.

FIG. 178.



DESSAIGNE'S EMBRYOTOME.

The instrument is made lighter without losing strength by the blades being fenestrated (see Fig. 175). We can affirm from experience that it works well. It is longer than any other English cephalotribe, and is easily adapted to the

differences between Barnes's and Braun's instruments. Barnes's was modified from Simpson's. It was made by him with successive improvements in 1862, 1863, and 1864. It might be further improved by giving it a slight perineal curve.

d above the brim. The perineal curve enables the operator to seize the d in its transverse diameter, thus preventing the blades from slipping kwards, as the ordinary cephalotribes are apt to do during the crushing he head. Tarnier has also adapted the perineal curve to the cephalotribe. eduction of the head-globe by lamination or slicing is a thoroughly ntific operation. It has been practised by Barnes and Tarnier.

. powerful embryotomy scissors is sometimes useful for decapitation, and dividing the spinal column in cases of advanced evolution.

amsbotham's decapitating hook has a moderately cutting inside edge. an efficient instrument. In Germany and Italy Braun's blunt hook is erred, perhaps with reason. It is twelve inches long; the greatest width he hooked part is one inch; the stem is from four to five times as thick. zati introduced a gentle curve into the stem near the hook.

n improvement on these hooks will be found in Dessaigne's embryotome Figs. 177, 178).

ibemont-Dessaigne's embryotome is an ingenious instrument which en- s a cord to be passed over the neck or trunk of the fœtus when it is ed to perform decapitation or detruncation. The part B is passed over fœtus in the same manner as Ramsbotham's decapitator; the part C assed up to meet B, into which it is fixed by the clasp D; the conductor then draws the cord through the instrument so as to leave two free ends. se ends being drawn to and fro in the manner of a chain saw quickly easily bisect that portion of the fœtus embraced by the embryotome. instrument is easier to apply and easier to manipulate than the ordinary apitator.

Barnes's Hydrostatic Bags.—Many defective models are sold. There uld be a series of three. The general shape is that of a fiddle. The er border should be slightly concave, so that the head-globe may rest in concavity. The sides should be concave, so as to be embraced by the vix, thus obviating slipping into the uterus or back into the vagina; the ending force is thus expended upon the crevix with slightly superior e at the ora internum and externum. They should be made of good lia rubber. They are introduced by help of a sound, which, fitting into a all pouch near the fundus, carries the bag up into place. The permanent nd running in the centre of the bag, which some have thought an im- vement, is really a fault (see Fig. 167).

To carry the whole of the foregoing armamentarium in one bag would be erally inconvenient. The best plan is to stow in one bag the instruments l medicines most frequently needed, including the essentially conservative liances. These are: the forceps; Robertson's instrument to replace the is; an apparatus to restore the child from asphyxia; bistoury and scis- s; sutures; ligatures; elastic bougies; elastic or glass catheter; Higgin- 's syringe with Neugebauer's glass uterine tube; the hydrostatic dilators; ypodermic syringe; Aveling's transfusion apparatus.

Medicines: chloroform or ether; ether for subcutaneous injection; tinct- of opium; nitrite of amyl; ergot; perchloride of iron, solid; carbolic d, 1 in 5, for dilution; bichloride of mercury, solution, 1 in 20; carbol- d vaseline.

The things specified do not occupy much room. They will carry the stetrist through most of the emergencies of labor. When it becomes a estion as to sacrificing the child, there is generally time to send for the crificial instruments, which may be kept in a separate case.

CHAPTER XXV.

DYSTOCIA: DEFINITION; DESCRIPTION. DISTINCTION BETWEEN SYMPTOMS AND CAUSES; THE SIGNS; THE CAUSES. ANALYSIS OF DERANGEMENT OF THE THREE FACTORS OF LABOR: (1) DISORDER OF THE EXPELLING FORCE; EXCESS, DEFECT; FROM FAULT IN THE PASSAGES, SOFT PARTS, CERVIX UTERI, VAGINA, VULVA, UTERINE TUMORS, EXTRA-UTERINE TUMORS, PROLAPSE OF THE UTERUS; HYPERTROPHIC ELONGATION OF THE CERVIX; PREGNANCY IN ONE HORN OF BICORNUTE UTERUS. (2) DEFORMITIES OF SPINAL COLUMN AND PELVIS; THE RICKETY PELVIS; OSTEOMALACIC PELVIS; TRANSVERSELY CONTRACTED PELVIS; KYPHOTIC PELVIS; FUNNEL-SHAPED PELVIS; SPONDYLOLISTHETIC PELVIS; OBLIQUELY OVATE PELVIS; THE THORNY PELVIS; TUMORS; FRACTURE; THE SPLIT PELVIS. (3) FROM FOETUS: MALPOSITIONS; PATHOLOGICAL CONDITIONS. CLINICAL CLASSIFICATION OF CASES OF DYSTOCIA; IMPACTION; ARREST.

THE term "Dystocia" comes down to us from Hippocrates. Dystocia stands in contrast with Eutocia. In the chapter on labor the meaning attached to the word "eutocia" has been sufficiently illustrated. Definitions or complex states are difficult, if not impossible. The more we endeavor to fulfil the great desideratum of a definition, to be concise, the more shall we be wanting in precision. We may, however, usefully accept the following propositions as generally true: "Eutocia is labor proceeding smoothly and terminating favorably under the natural forces." On the other hand, dystocia may be defined or described in the wards of Harvey: "Fit partus *difficilis et laboriosus* quod nec modo neque ordine debito res peragatur, aut pravis aliquibus symptomatibus impediatur." To this may be added labors requiring assistance.

The problem of dystocia is often needlessly obscured by confounding definition and symptoms with causes. The surgeon, at the bedside, must pursue the clinical and analytical method, if he would solve the problem in a manner useful to the patient. He must carefully observe the symptoms, subjective and objective, and then proceed to weigh their significance and trace them to their causes.

We start, then, by observing the course of the labor. The points for observation are: (1) the time spent in the process; (2) the character of the pains; (3) the effects upon the system generally. In this way we shall determine whether or no the case is going on smoothly, or if the woman is drifting into danger, and what are the symptoms that dictate the necessity for interfering.

Having arrived at the conclusion that help is needed, we then search for the cause of the dystocia; and remembering that dystocia may arise from error in any one or more of the three factors of labor—that is, of the body to be expelled, of the resisting force or of the expelling force, or from a loss of correlation between these factors—we may, by careful investigation into the conditions and relations of these factors, hope to arrive at precise indications for treatment.

The scheme of this chapter, then, will be: (1) to describe the symptoms of dystocia; (2) to study the causes according to a systematic classification based upon the deviations from the standard characters of the several

ors of labor; (3) then to revert, in conclusion, to the clinical classifica- of cases of dystocia. On this principle, then, we shall first study the cts or disorders of the expelling force; next, the difficulties arising from vorable conditions of the parturient canal, whether in its soft or bony ents; and, thirdly, the difficulties that arise from the fœtus, whether disproportion, malposition, or other complications.

A. The Signs of Dystocia.

he *general signs* are: Pain, affecting the heart's action; a kind of shock; ability of temper; anxiety; restlessness; continuous pain, exacerbated eturn of the uterine contractions; tenderness on pressure upon the is; the uterine contractions assuming a peculiar abortive or fleeting acter—that is, having a wearing, irritating effect upon the system, and ing a sense of having been of no use in advancing the labor—"they do ood." The woman, instead of aiding "the pains" with a cheerful will, ds their return, is careful not to add force to efforts which she feels will seless and which exhaust her strength. If with these symptoms the e rise to 100 or more, and maintain a high rate during the intervals of ine contraction; if there be a hot dry skin or profuse perspiration, a ty secretion of high-colored urine or vomiting, which is now of ominous ort, being no longer the result of healthy reflex excitation, but of pros- on and metastatic or perverted nervous action, there is obstructed labor.

THE LOCAL SIGNS. — When, in addition, tactile examination discovers t tenderness and heat of the vagina, tumid or unyielding state of the d cervix uteri, continuous rigidity of the uterus, spastic contraction in ntervals of the pains (Braxton Hicks), stationary position of the fœtus, easing tumefaction of the scalp or other presenting part, and exudation yellow serous discharge, there is dystocia. The surgeon is called upon t. His first duty is, plainly, to discover the cause of the dystocia; the d, is to study and to apply the proper remedy.

he element of time must be considered. Dystocia, it is true, cannot be ated by the clock. Although the signs enumerated are not often devel- in a few hours, estimates based upon time are mostly fallacious. It is ult to tell with any preciseness when labor began, so as to obtain a point eparture for calculations. Lingering during the first stage is not gen- y attended by much constitutional or local disorder. But, generally, igns of dystocia will not be long deferred after the rupture of the mem- es. Then, if severe pains continue to recur, and the labor makes no factory progress, the question of giving help becomes urgent.

B. The Causes of Dystocia.

e first inquire: Does it lie in disorder of the expelling force? The lling power may be faulty in two principal ways: in defect or in ss.

efect of expelling power may vary in degree. There may be enough to e the child through slowly, tediously, constituting lingering labor. e may be power enough to drive the child a part of the way, when the flags or ceases. This is what is understood by *inertia*. The term is ive.

after some hours, the signs of dystocia not being developed, we find the r at a standstill and the pains deficient, and if, on internal exploration,

we are satisfied that the pelvis and soft passages offer no obstruction, if the fœtus present favorably and offer no obstruction from disproportion, we infer that the fault lies in defect of expelling force. The history of previous labors will serve to solve the question of pelvic deformity.

Inertia is compensated for in two ways: by adding force *à tergo*, and by applying force *à fronte*. Putting aside oxytocics, the objections to which will be set forth presently, we will only state here that *vis à tergo* is best applied by "expression," and *vis à fronte* by the forceps.

Excess of Expelling Power.—This may be inferred if the contractions are strong and regular and yet fail to propel the child. Excess of expelling force may be the result of undue call upon the diastaltic function in answer to undue resistance. It implies, then, a want of correlation between the factors of labor. It is therefore necessary first to determine if there be obstruction; and if this cannot be readily removed, the rational course will be to moderate the driving force, lest injury to the soft parts or to the fœtus result. By the judicious use of epichontocics, as chloroform, nitrite of amyl, or chloral, violent action of the uterus may be subdued, and time given for the application of *vis à fronte*, should this be called for.

Dystocia from Fault in the Passages or Undue Resisting Force.—The fault may lie in the condition of the soft parts, or in that of the bony canal. It is convenient in the first place to enumerate the difficulties that arise from the soft parts. The first obstruction is encountered at the cervix uteri. This refuses to expand to receive and transmit the child. There may be rigidity. The os externum is felt hard, as a tight ring, unyielding under strong driving force. This condition is due in some cases to hyperæmia, hyperplasia, or hypertrophic induration. This is especially the case in pluriparæ. It may be simply spasmodic, the result of loss of harmony between the expelling and resisting forces. This is metastatic nervous action, or perverted polarity, the excess of contractile energy being transferred from the fundus uteri to the cervix. This occurs not unfrequently in primiparæ. A frequent cause is premature escape of the liquor amnii, so that, the natural dilating factor wanting, the presenting part of the child comes to press directly upon the cervix.

Other obstructive conditions are: swelling of the cervix from thrombus, a fibroid tumor, cancerous degeneration. A condition commonly described, but very rare, is occlusion of the os by a false membrane (Naegelé). Occasionally, it is very difficult to make out the os uteri; there is nothing but a smooth surface at the vaginal roof. But with care and patience a small dimple will almost always be found, which represents the os. In one case, although the lips of the os could be distinguished, a thick membrane was continuous with the circumference, completely closing it. This membrane we concluded to be formed by chorion and amnion, which had become closely adherent to the lower zone of the uterus. In a case under Dr. Fancourt Barnes, at the British Lying-in Hospital, of a young primipara, there was complete atresia of the vagina from one inch of the vulva upwards, excepting a minute canal, admitting a probe with difficulty. When in labor, no presentation could be felt through this obstruction. It was dissected up by the knife, and the uterus reached. The dilatation was enlarged by stretching with the fingers; a living child was delivered by forceps. Notwithstanding the severe injury inflicted, the patient made a good recovery. Beyond a history of scarlatina when a child, no fact bearing upon the atresia was elicited.

Although it can rarely occur that dystocia is due to one simple cause—for any one cause is almost sure to entail other disturbances, so that dystocia

is almost necessarily a complex condition—it is convenient to trace separately the methods of treating the dystocia that arises from fault in the soft passage.

In the first place comes the question of how to act when there is *inertia*. This raises at once the question of the uses and dangers of ergot and other oxytocics. We seek by this aid to excite the uterus to more vigorous action. Before resorting to them, it is of vital importance to determine first the whole conditions of the labor, the individual state of each of the three factors, and their correlations. Before whipping up the uterus to increased exertion, we must be satisfied that there is no obstacle in front so great that reasonable increase of driving force will not overcome without injury. We must be sure that there is no marked rigidity along the parturient tract, no distortion or contraction of the pelvis, no disproportion or malposition of the fœtus, or other obstructive complication. This postulate is not always easy to obtain; and error or miscalculation may entail serious, even fatal, consequences. This is one objection to ergot. There are many others. The case, once entrusted to ergot, is likely to be beyond our control. We have evoked a brutal power like that given to Frankenstein. Ergotism, like strychnism, will run its course. If it act too long or too violently, you cannot help it. You may try epichontocics, as chloral, nitrite of amyl, or physostigma, but these may fail. The ergotic contraction of the uterus when characteristically developed resembles tetanus. Then woe to the mother if any obstacle should delay the passage of the child. And woe to the child if it be not quickly born. The ergotic contraction does not observe the physiological character of alternating diastole, systole, and repose—conditions necessary to the orderly circulation of the blood through the uterus, placenta, and fœtus.

Again, ergot may cause such vehement reflex straining that, the glottis being too long closed, rupture of air-vessels ensues, entailing emphysema of the neck, and perhaps extending widely. This we have seen several times. Another accident is the possibility of ergotic poisoning producing gangrene. This effect, well known in Germany from eating ergotized bread, is not unknown in obstetric practice. Dr. Begg relates a case ("Lancet," 1870) of a young woman who took 65 grains of ergot during labor. Signs of extensive peripheral gangrene set in, ending in the amputation of both legs and arms, and, strange to say, survival. Lastly, McClintock and others contend that ergot exercises a direct toxical effect upon the fœtus. Quinia is open to less objection, but it cannot be depended upon.

If it be urged that accidents are exceptional and overdrawn, and that innumerable cases may be opposed to them in which no injury could be traced, the reply is that these accidents have occurred, and that we cannot, when giving ergot, be sure that a catastrophe of the kind will not happen again. Should we not prefer to use weapons that will obey us, that will do as much, and not more than we desire?

There are such weapons, and, in competition with these, there is no excuse for resorting to ergot. There are means which, used singly or in combination, will rarely fail to accomplish what is wanted with all the precision, safety, and certainty that science can demand. Thus they differ from the brutal, intractable action of ergot; they admit of precise adaptation, in time and degree of force, to the peculiarities of the case in hand. Various means come successively and gradually into use according to the measure of the difficulty to be overcome. Thus, in the minor degrees of simple inertia, compression of the uterus by the hands, pushing the contents down in the axis of the pelvis, may suffice. We may sometimes succeed in exciting the uterus to contract by passing a flexible cathether or bougie into the uterus,

so as to reach the fundus. It is an application of the labor-provoking agents to the acceleration of labor.

To overcome rigidity in the first stage several methods are described and practised. Chloroform is often of signal service. It acts by annulling the sense of pain, and by restoring the equilibrium of the nervous system, by removing disturbing influences that divert the nerve force from its proper distribution; the sphincteric spasm relaxes, the body of the uterus contracts as it ought to do, and the labor proceeds. Tincture of opium or Hoffman's anodyne in half-drachm doses, separately or combined, are almost equally efficacious. Chloral is sometimes superior to opium. It produces unconsciousness without stopping uterine contractions. It may be given in fifteen-grain doses every fifteen minutes, until the desired action is observed. But this caution we insist upon: *not to exceed four doses.* Another mode of giving chloral is to inject half a drachm into the rectum by enema.

Tartar emetic was at one time much used. It has occasionally answered our expectations; but we prefer means more certain and less distressing.

Bleeding is out of fashion. In this country few men are in a position to speak of its use in this connection from experience. We are among the few. In some cases of robust florid women, struggling strongly by reflex or semi-voluntary straining in aid of powerful uterine action, the abstraction of ten ounces of blood from the arm has been quickly followed by complete relief. The rigid cervix expanded easily, and possibly effusions were avoided. But the cases where it is wise to resort to venesection are rare.

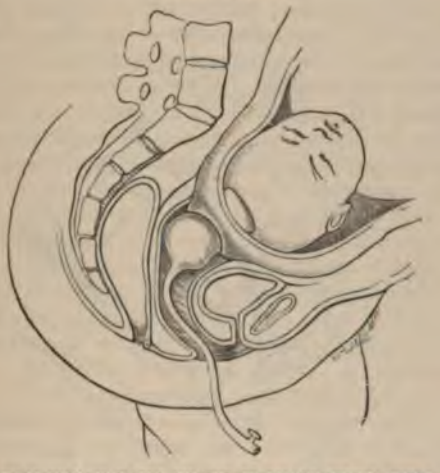
Warm baths might be useful; but the inconvenience attending their use puts them out of the list of available remedies. The best method of using hot water is by vaginal irrigation. A stream of hot water is kept up for a few minutes, taking care that the tube does not enter the cervix uteri.

The most certain of all methods is water-pressure applied by means of Barnes's hydrostatic bags. By this means, not only is the natural force which expands the cervix closely imitated, but the diastaltic function is roused, and healthy, orderly uterine contraction is excited, if there be the proper reserve of nervous energy. If this fail, then we put on the *vis a fronte* by the forceps. There is no violence; all the physiological requirements are respected. We help nature after her own dictates, and exactly to the measure of her need. In some cases, in which the second stage of labor is somewhat advanced, the cervix may sometimes be dilated by the hand. Two or three fingers are insinuated within the os, so as to form a conical wedge. This wedge is gently and gradually pushed forward into the cervix, and, widening as it goes, the cervix yields. This wedge has the advantage of being a sentient force. It tells you what it is doing, and conveys information as to how you should proceed. Sometimes, indeed, you learn this: the fingers with their hard joints make a painful and irritating wedge. As it proceeds, it is apt to renew the spasmodic contractions we have taken pains to allay. If the head is pressing upon the cervix, it may be useful to help the dilatation by hooking down the anterior lip with one or two fingers, holding the os open, as it were, to allow the head to engage in it. But this application is limited. What is called manual dilatation of the spasmodic cervix should be abandoned, except in the case of spasmodic contraction after expulsion of the child—as, for example, when the placenta is retained, or clots are filling and irritating the uterus.

Water-pressure is the most natural, the safest, and the most effective agent. An os uteri that will admit one finger will admit No. 2 dilator in the collapsed state. The introduction is effected by inserting the point of the sound or any convenient stem into the little pouch at the end of the bag; the bag is then rolled round the stem, lubricated with a little soap, and—guided by the

forefinger of the left hand—slipped into the cervix. Sometimes it is easier to seize the bag by a long speculum-forceps. When the bag is carried so far that the narrow or middle part is fairly embraced by the cervical ring the sound is withdrawn. Water is then pumped in gradually, so as to distend the bag until it is felt tightly gripped by the os. Then wait a while; close the stop-cock, and give time for the distending eccentric force to wear out the resistance of the cervix (see Fig. 179). No muscle can long resist a

FIG. 179.



SHOWING APPLICATION OF WATER-DILATOR TO DILATE CERVIX UTERI. (R. B.).

continuous force. From time to time inject a little more water so as to maintain and improve the gain. Care must be taken not to distend the bag beyond its strength lest it burst. This, we are told, has happened; we believe it need not happen if the bag is well made and properly used. When the dilatation is carried as far as No 2 will do it, substitute No 3, which is larger and more powerful. The dilatation obtained by No. 3 is commonly enough to enable the forceps or the hand to pass. The time required for this dilatation may range from half an hour to two hours. It is desirable to keep the finger on the os, so as to be sure that the bag does not slip up into the uterus or down into the vagina; if it slip up, it may displace the head—in either case, time may be lost. When the due dilatation is attained, open the stop-cock; the water is ejected in a stream, and the bag is easily withdrawn.

The proceeding just described will succeed in the great majority of instances, especially where the closure of the cervix is due to spasmodic action, or where, the tissue of the cervix being normal, it cannot expand for want of an eccentric expanding force, as when the bag of membranes or the child does not bear fairly upon it.

But in certain cases, where there is alteration of tissue—as œdema, hypertrophy, cicatrix—something more is required: this is *incision*. This method has long been practised. Coutouly, Velpeau, Hohl, Scanzoni, and many other eminent men resorted to it. Judiciously employed, the knife can do no harm; it will save life where nothing else can. We are sometimes in the presence of the following alternatives: exhaustion, sloughing or rupture of the uterus on the one hand, or the timely use of the bistoury on the other.

There are various cases in which *vaginal hysterotomy* or *dilatation of the cervix by incisions* is necessary. First, no os uteri can be found; it may be

closed by false membrane or atresia. Pressure with the finger or a sound will mostly break down a false membrane, and offer a sufficient opening to admit a hernia-knife. The forefinger of the left hand is kept on or in the os uteri as a guide (see Fig. 180); the knife is then slipped up, lying flat upon this finger, until its cutting edge is within the os; this edge is then turned up, the back supported by the guiding finger, and an incision is made about a quarter of an inch deep in the sharp ridge of the os; the edge is then carried round to another part of the ring, and another nick is made. In this way four or five nicks may be effected. Each gives perhaps little, but

FIG. 180.

SHOWING MODE OF DILATING CERVIX BY INCISION.

the aggregate gain of these minute multiple incisions is considerable. We do not think it matters much at what points of the circumference of the os these incisions are made; perhaps the two sides are to be preferred. Before extending or multiplying these incisions it is proper to observe the effect of uterine action in carrying out the dilatation. It is quite surprising to observe how rapidly and smoothly spontaneous dilatation sometimes take place when these small incisions have taken off the morbid tension; it seems as if in a moment the due polarity and action of the uterine contractions, and the due relation between the factors of expulsion and resistance, were restored.

If the spontaneous dilatation fail, we turn to the hydrostatic dilator. This plan of combining water-pressure with small incisions is especially valuable in cases of rigidity from hypertrophy of the cervix or of atresia from cicatrix.

If it be found necessary to put on *vis à fronte*, the forceps carefully used may complete the dilatation. One blade is passed and the effect is watched; the second blade passed and the head grasped, the head is drawn steadily down, and by keeping up gentle traction the wedge formed by the blades and head will gradually dilate the os, perhaps enough to allow the head to

pass, and thus to save the child's life. But this must be done with great caution and delicate manipulation, and not be persevered in, unless the cervix yield readily. It is best to wait awhile, according to the condition of the patient.

It will occasionally happen that neither by incision, by water-pressure, the hand, nor the forceps, can a sufficient opening be obtained without danger of laceration or other mischief. In such a case it will be necessary to restore the equilibrium between expelling and resisting forces by reducing the head to the capacity of the cervix by perforation.

Narrowing and rigidity in the vagina must be treated on the same principles. The small rigid vagina of a primipara is best dilated by hot water irrigation and the larger-sized hydrostatic dilators, or Braun's *colpeurynter*. This plan will often shorten labor in a remarkable manner. Atresia from cicatrices presents a more formidable obstacle. The passage may be so constricted by dense cartilaginous tissue as to permit no more than a probe to pass. A careful process of incisions, multiplied in all points of the circumference, alternating with water-pressure, is necessary; and it is, after all, probable that the difficulty will have to be met half way by perforating the head. In such a case the after-treatment is important. A lady, having been left many hours in labor, head in pelvis, was at last delivered easily by forceps; extensive sloughing of the vagina ensued, resulting in dense cicatricial closure. Again pregnant, we induced labor at five months, not daring to let her run the risk of laceration or rupture that must have attended prolonged gestation. The labor had to be effected by incisions, water-pressure, and craniotomy. On her recovery we obtained and kept up a fair degree of dilatation by repeated incisions, bougies, water-pressure, and wearing pessaries, so that when again pregnant we were able to deliver, after dilatation by water-bags, a living child by forceps. In a subsequent labor she was delivered without operation in the country. This case is a happy illustration of the effect of chronic treatment upon cicatricial tissue. This tissue has but slender vitality; if kept on the stretch it often undergoes gradual atrophy.

Obstruction at the vulva and perineum must also be met on the same principles. In the ordinary case of tense, rigid vulva and perineum, we may first use free irrigation or fomentations with hot water; chloroform or nitrite of amyl may help by subduing voluntary expulsive effort. If the perineum does not dilate, it is very likely to burst, and if this begin, we can hardly prevent it from running back through the sphincter ani; and if the perineum does not yield, something else must. The uterus may cease to act, or, struggling in vain, it may burst itself or the vagina. In this way the rupture of the perineum may be regarded as a conservative accident; it is the lesser evil. These dangers you may avoid by incisions. The forefinger is passed between the head and the edge of the vulva, and two or three small nicks are made on either side, nearer to the posterior commissure than to the anterior. The relief sometimes gained in this way is surprising. Spasm, irritation, and pain subside, the vulva dilates, and labor is soon happily at an end. The bleeding is insignificant, and the minute wounds left when the parts have contracted quickly heal.

It is a thing to remember that these minute incisions made at the os uteri and vulva are wounds no greater, often less, than those which Nature herself commonly inflicts in ordinary labor. They are but a small price to pay for the escape from wounds of uncertain, probably dangerous, extent.

Obstruction from *serous infiltration of the labia* must be met by multiple pricks or stabs with a lancet, or, if seen beforehand, by Southey's drainage-trocar needles. This proceeding is extremely important. If the swelling—

which, in cases of albuminuria, is sometimes enormous—be not thus reduced, not only laceration, but subsequent sloughing or gangrene may ensue.

A considerable number of cases are now recorded of obstruction to labor from the hymen. The treatment consists in incisions of the obstructing membrane and dilatation by the water-bags.

Obstruction by *thrombus* must also be met by puncture.

In cases of obstruction by tumors or cancerous growths otherwise insurmountable, recourse to the *ultima ratio*, the Cæsarean section, is indicated.

The Tumors that interfere with the Course of Labor.

These may be divided into two classes: tumors which are strictly uterine, and those external to the uterus and independent of it. The complication with tumors, in so far as gestation is concerned, has been studied in the chapter or "Diseases of Gestation." This forms a necessary introduction to the history of labor and puerpery complicated with tumors.

1. Uterine Tumors.—These, again, may be subdivided into: tumors which are embedded in the uterine walls, mural tumors; those which project upon the outer surface, subperitoneal; and those which project into the uterine cavity, submucous or polypoid tumors. The complication of gestation with uterine tumors has been referred to, p. 253. We have now to study how these tumors affect labor, and how to meet the difficulties arising from this complication.

It may be stated, in the first place, that uterine tumors are more or less dangerous according to the position they occupy. Thus, subperitoneal tumors may entail no trouble in labor. Mural tumors or submucous tumors, if occupying the lower region—and which are, therefore, most exposed to injury during labor—are the most dangerous; whilst those seated in the fundus above the child are comparatively free from mechanical injury. They are not, however, altogether free from the danger of inflammation, and are not unlikely to cause hemorrhage.

Closely allied to the muscular tumor in the uterine wall is the *muscular polypus*, which, attached by a stalk, projects into the uterine cavity, or through the os uteri into the vagina. Such a polypus may obstruct labor by getting out of the uterus before the head and blocking the vagina. A case of this kind occurred in St. Thomas's Hospital Maternity. A solid polypus as large as a full-sized cocoa-nut blocked the vagina. Dr. Gervis found that some laceration of the surface of the polypus had occurred, and that with every pain it became extremely tense and elastic. The child was delivered by craniotomy, and a second one by turning. The tumor after labor protruded through the vulva. It was removed by écraseur five days afterwards. The woman died on the thirteenth day. There was peritonitis. The tumor was a myoma enveloped in a capsule of true uterine tissue; low necrotic inflammation was progressing in its substance. In St. Bartholomew's museum is a large polypus removed by excision, first discovered after labor. The woman recovered speedily. It is probable that the tumor was above the child during labor. This was the case in the late Dr. Crisp's case. The placenta being retained, Crisp introduced his hand and removed it. He thought he felt another child, but a large polypus was found, causing violent expulsive pains, greatly exhausting the patient. The violence of the pains forced the polypus so low down in the vagina as to interfere with the passage of the catheter. The patient died collapsed, worn out by the constant uterine spasm. There was no hemorrhage. Violent uterine action has been observed in other

cases, namely, in one related by Mr. Freeman,[1] and in one by Dr. Priestley.[2] Ingleby and Gooch relate fatal cases. In one case related by Beatty inversion of the uterus was produced by the tetanoid action set up by the tumor.

These cases are good illustrations of the issues when polypus complicates labor, and they indicate the rule of treatment. These issues may be summed up as follows: The tumor gets bruised and undergoes necrotic inflammation, leading to metroperitonitis and septicæmia; imperfect contraction may lead to hemorrhage; uterine tenesmus or tetanus may cause collapse and exhaustion; the continuing expulsive action may lead to inversion of the uterus.

The treatment indicated, then, is, in the case of a polypus lying in front of the child, to remove the tumor by écraseur before the head is driven down upon it. The obstruction to the labor, violent action of the uterus, and injury of the tumor and the structures to which it is attached, are all obviated by this operation. When the polypus lies above the child, and only comes into evidence after the child is born, the indication is still to remove it by écraseur or galvanic wire cautery as soon as possible. The operation in either case is simple, and infinitely less dangerous than leaving the tumor.

If in some cases the changes induced in the tumor under the influence of labor lead to the death of the patient, in others the labor acts in a happier manner—the tumor disappears. This may be brought about in at least two ways: First, myoma, being constituted of tissues analogous to those of the uterus in which it arises, grows with the uterus during gestation, and follows also the same law of involution after labor. In this way it is noticed that tumors, ascertained before gestation to be of a definite size, have grown considerably during gestation, and after labor have receded to their pregravid condition, no ill-effect being observed during gestation, labor, or puerpery. In other cases, either by an exaggerated process of involution or by atrophy, the tumors have entirely vanished, leaving not a trace behind. We have seen such cases, one quite recently; the patient recovering after severe hemorrhage and signs of septicæmia. Pagan relates a case. Leonard Sedgwick relates[3] two cases. Montgomery cites similar cases. Playfair relates[4] a case. There is yet another way in which labor may be said to cure or remove fibromyomas: the crushing so injures their substance that they fall into disintegration by sloughing, and this process being limited to the tumor, it is cast out of its investing capsule, and is expelled by liquefaction in shreds or masses. This expulsion may be accomplished several weeks after labor. Robert Barnes exhibited to the Obstetrical Society a large tumor thus expelled. It seems that during labor loosening of the attachments takes place, favoring enucleation. Danyau and Matthews Duncan each relate a case in which partial enucleation thus effected was easily completed surgically. The great decrease in size of the uterus and its persistent contractions tend to cast out the tumor.

The diagnosis of fibroid of the uterus complicating gestation and labor is sometimes difficult. If the tumor project on the outer surface of the uterus on the fundus—front or sides—the irregular prominence ensuing may make the diagnosis easy. But when the tumor is intramural or projects into the uterine cavity, especially in a region above the child, it may easily escape detection until after labor. When the tumor grows in the lower segment of the uterus or in the cervix, it comes more within the range of palpation. But the pelvis may be so blocked, the vagina and cervix so distorted, that access for the examining finger below may be impossible. The mystery may,

[1] Obst. Trans., vol. v.
[2] Ibid. vol. v.
[3] St. Thomas's Hosp. Reports, 1870.
[4] Obst. Trans., 1877.

however, be cleared up by making repeated examinations. The comparative observations may reveal changes of form, size, and relation. Auscultation may be expected to detect the fœtal heart. But great caution is required, if a uterine rush only is heard, not to assume that it must be due to gestation; it may be produced by the tumor itself.

Tumors outside the uterus and pelvis may affect labor: 1. By pushing the uterus away from the pelvic axis, preventing the child from entering, or by causing malposition. 2. By impeding or disordering the expulsive forces. 3. Cysts may burst, causing shock and internal hemorrhage or inflammation. The principal of these are *ovarian tumors*.

We have seen (see p. 253) that the ovarian tumor acted upon by the growing uterus may suppurate, burst, or become strangulated by rotating on its pedicle. Any one of these accidents may happen towards the end of gestation and during labor. This may occur even when the tumor has offered no material obstruction to the passage of the child. But where the tumor is lodged partly or wholly in the pelvis, unless it be movable, it can hardly escape injury, and by encroaching on the pelvic space it obstructs the passage of the child. Rupture is then more likely to happen; the dragging or stretching of the structures to which it is attached may set up pelvic and abdominal inflammation; and the bruising its own structures undergo may prove fatal.

It is well known that many women have gone through several labors without accident under complication with ovarian tumors. But this happy event can in no case be counted upon. Such immunity must be looked upon as a fortunate escape from imminent peril, and histories of this kind ought not to encourage a policy of expectation. Not a few women, after escaping once or oftener, have in the end fallen victims to one or other of the catastrophes recited.

Mr. Berry reports[1] an extraordinary case, showing what narrow escapes sometimes occur. Labor had been obstructed by an ovarian tumor, and the child had been extracted with considerable force by forceps. Next day, after coughing, the patient felt something come down; this was found to be an ovarian tumor, the pedicle of which was traced through a rent in the upper part of the vagina. Mr. Berry thought the rent might have been caused by the forceps; but it is quite possible that in such a case rupture might occur spontaneously. A ligature was put on, and the tumor was cut off. The woman recovered. The preparation is in St. Bartholomew's museum. Luschka relates[2] a case of an ovarian tumor coming out through the vagina.

Dermoid cysts resemble in many features the ordinary cystic ovarian tumor. They more frequently occupy Douglas's pouch, and thus get below the uterus and child. They may feel so hard as to suggest solidity; but on puncture fat may run out, as in a case of Ramsbotham's,[3] in others related by Ingleby, and in a case of our own. Denman cites a case where labor was obstructed by a dermoid cyst between the vagina and rectum; the head was perforated, but the woman died from the injury inflicted upon the tumor and surrounding parts. In a case under Fancourt Barnes at the British Lying-in Hospital, the pelvis was nearly blocked by a dermoid cyst. After a protracted labor he performed the Cæsarean section after Porro's method. The woman died on the fifth day. The tumor was found inflamed.

The tumor formed by an ectopic gestation is one of the most remarkable and dangerous complications of labor. The danger of the cyst bursting during

[1] Obst. Trans., vol. viii.
[2] Monatsschr. f. Geburtsk., 1867.
[3] Path. Trans., vol. iv.

r is very great, and if it does not burst it may become the centre of l inflammation. A case of recovery is related by Perfect; we cite it as pical example. The woman had had one child, and thought she was nant again. At the end of nine months she had some pains, which went and the tumor grew less. A hard indolent tumor remained in the right Menstruation returned, she conceived again, and at the end of nine ths she was delivered of a healthy child. The tumor was still felt as re. Five days later violent fever, purging, pain in the tumor, profuse l sweats set in. After nine weeks, fluctuation was manifest in the tumor; as opened, a vast quantity of fetid matter escaped, and a fœtus of com- size was extracted through the incision. It was imagined that the enta had dissolved into pus. The woman recovered and suckled. The was fortunate. Two cases are recorded by Greenhalgh.[1] In one the or obstructed labor; it was pushed up with some force out of the pelvis, the child was delivered by turning, dead. The woman died two days rwards. A full-grown fœtus, contained in its membranes unruptured, found in the peritoneal cavity. Greenhalgh's second case is briefly as ws: A twin extrauterine fœtation obstructed labor; the forceps was lied to the uterine child. The woman recovered, with discharge of fœtal s. Montgomery collected several cases of women bearing uterine dren, several times successively, an extrauterine gestation persisting ughout.

retrouterine hæmatocele may form a tumor obstructing labor. In a case by us, the mass of semisolid blood was expelled by the rectum.

bdominal tumors may obstruct labor or entail dangerous consequences. these the principal are hydatid cystic disease of the liver, cystic disease he kidney, and malignant tumors of the omentum. The dangers attend- cystic disease of the liver and kidney, as bursting or inflammation, may verted by tapping. This is best done by the aspirator-trocar.

he distended bladder may be carried down before the head, and present a e fluctuating tumor at the vulva. The diagnosis and treatment of this plication offer no difficulty if the good obstetric rule of passing the eter in every case of tedious labor be observed.

umors in the vagina and vulva may offer great obstruction, but the cases generally less serious because the tumors are more within reach of opera- measures. Cystic or fibroid tumors may spring from any part of the inal wall; they are rare. At the vulva condylomatous or cancerous vths of large size may obstruct labor, and if not removed before the pas- of the child may be so injured by crushing and tearing as to give rise emorrhage, sloughing, and septicæmia. Such growths should be removed he galvanic cautery or the écraseur. Bartholini's gland may be the seat of ic degeneration or abscess. The tumor presents an oblong, tense, red mass ying in size from that of a pigeon's egg to that of a hen's egg. It should aid freely open by the knife.

he diagnosis of ovarian tumors may be difficult when the complication presents itself at the time of labor. In some cases, the presence of rian tumor will have been known before the pregnancy began. But it emarkable that often no tumor is suspected until symptoms of distress set t an advanced period of gestation, or even before labor. Then we are led xamine. The symptoms are mainly those which result from mechanical ssure. Dyspnœa, quickened pulse, hectic, accompany excessive abdominal sion. All this may be due to excess of liquor amnii, to twin-pregnancy, scites. With care the two tumors, ovarian and gravid uterus, can gener-

[1] St. Bartholomew's Reports, 1865.

ally be distinguished. The outlines of the two masses, ovarian and uterine, are more or less distinctly preserved. Even through the abdominal walls the groove between the two may be felt; it gives the idea of a bilobed tumor; the distention of the abdomen is greater transversely in the flanks than in simple pregnancy; and the fœtal heart is heard very much on one side, and generally lower than it should do. And we have observed that the spot of greatest intensity of sound shifts its place as the gestation advances, and as the uterus is pushed more and more aside. The os uteri will probably be pushed a little on one side, and a portion of the tumor may be felt in the brim of the pelvis. Twin-pregnancy may give some of the characters described, as greater breadth of abdomen, and a depression or groove at the summit of the uterus; but these are much less marked, and if we detect two fœtal hearts the diagnosis is precise. A small ovarian tumor or an early tubal gestation may be diagnosed by the feeling a tense, elastic swelling in the roof of the pelvis, stretching the posterior wall of the vagina, and carrying the uterine neck forwards and the fundus to one side. The diagnosis is made clearer and a good therapeutical indication is fulfilled by puncturing the swelling by an aspirator-trocar.

The uterus deformed by myoma has been mistaken for a uterus bicornis. Nor is the diagnosis easy even after the embryo has been expelled.

The treatment or management of gestation and labor complicated with ovarian tumors has been discussed so far as gestation is concerned. This, in fact, is the proper time to act. But the opportunity does not always present itself. The rule of conduct should be based upon the general law of giving primary consideration to the safety of the mother, regarding the fate of the child as of secondary importance. Indeed a rigorous analysis will show that the best hope of rescuing the child will in many cases depend upon our success in saving the mother.

The fact which stands most prominently out, is that a main source of danger is the injury the tumor undergoes, especially during labor. The risk of bursting, of strangulation of the tumor, and of consequent shock, hemorrhage, and peritonitis is so great, and the catastrophe comes with so little warning, that the question whether it is ever prudent to let gestation and ovarian tumor proceed together compels attention. To do nothing because gestation and labor have been often carried through without mishap is simply trusting to chance. It is a surrender of judgment but too likely to entail unavailing regret. We have no means of foretelling whether or no a particular tumor will burst or become strangulated. The fluid tumors are more likely to burst; the more solid ones are liable to twisting, strangulation, and perforation. Both kinds may give rise to unexpected obstruction to labor, and undergo fatal injury during the process.

The point to which all reasoning converges is to reduce the case to its simplest expression by eliminating one or other of the complicating factors. Which shall we select for elimination? At one time we held that it was best to end the gestation by inducing labor, leaving the tumor for subsequent treatment. We are now convinced that it is best to eliminate the tumor. The question how to act, when labor is present or at hand, is more difficult of solution. We cannot lay down an absolute rule to govern all cases. If the tumor admit of removal without dangerous action upon the uterus, it is better, even during labor, to perform laparotomy and remove it. If sudden shock, with or without severe collapse, indicating bursting or twisting of the tumor or rupture of the uterus, occur, it is, we think, imperative to lose no time before opening the abdomen, to discover the precise nature of the injury sustained, to remove the ovarian tumor, and, if the

uterus have been injured, to consider the expediency of performing the Cæsarean section, simple or according to Porro's method.

In the next place we have to discuss how to act when labor is obstructed by tumor. Up to a certain point the principles of acting are the same, whether the tumor be ovarian or fibro-myoma.

The first question to determine is, *Can the obstructing tumor be pushed out of the way?* Many cases of ovarian tumor and some of fibro-myoma are movable, and admit of being lifted above the pelvic brim, so that the child can find room to pass. This may be done by the hand. The operation will sometimes be facilitated by placing the patient in the knee-elbow posture. Now and then the tumor rises out of the pelvis in the course of labor, under the unaided action of the descending uterus and child. Beatty and Depaul relate cases in point. In one case, Dr. Kidd, of Dublin, carried a tumor out of the way by distending a Barnes's bag below the tumor in the rectum. Sometimes considerable force is required. In the case of solid tumors, it may be necessary to pass the whole hand into the vagina or rectum, and to push firmly in the axis of the brim or in the line of least resistance. The pressure should be steady and sustained. In the case of cystic tumors containing fluid such pressure might burst the tumor. If then it does not rise out of the way under moderate pressure, we have to choose between two courses: First, to lessen the bulk of the tumor by tapping. The aspirator-trocar is the best instrument. Before tapping the tumor, it is advisable to rupture the membranes, and let the liquor amnii drain off. This diminishes the tension. The best place to puncture the cyst, if it protrude into the pelvis and fluctuation be felt there, will be the most prominent part of the tumor behind the os uteri in the vaginal roof, or by the rectum if the cyst be more accessible that way. But if fluctuation be not felt in the vagina, it is better to puncture in the most prominent part of the abdomen, after carefully determining the position of the uterus by palpation and the seat of the fœtal heart. A large aspirator needle should be used. The cyst, if punctured by the abdomen, will probably collapse more completely, and we are more likely to avoid the solid basis which is so often found at the lower part of ovarian tumors. When the tumor has collapsed, the labor may go on without difficulty, aided, perhaps, by forceps. There is, however, reason to fear that inflammation may be set up in the tumor or adjacent structures, and lead to danger in puerpery. In such an event the expediency of an exploratory incision, with a view to removal of the tumor, must be discussed. Secondly, if the tumor does not undergo sufficient shrinking under tapping to permit labor to go on safely, there should be no hesitation in opening the abdomen to remove the tumor; and if it cannot be removed, then delivery by Cæsarean section is the alternative.

Playfair has examined the question how to deal with ovarian tumors by comparing the histories of nearly fifty instances[1] of labor complicated with ovarian tumor. He found that of the cases delivered by craniotomy more than half had terminated fatally. It might, he urges, be fairly assumed that, had the Cæsarean section been performed in these cases at an early period, the mortality of the mothers would not have been greater, whilst some of the children would have been saved. This reasoning is difficult to resist, but clearly it does not justify a uniform mode of procedure. The facts prove the extreme danger of dragging a child past a tumor, and that, in some cases at least, the Cæsarean section is the safer proceeding. When laparotomy has been performed with a view to Cæsarean section, it seems a reasonable thing to proceed to the extirpation of the tumor where practicable.

[1] Obst. Trans., vol. vii.

Indeed, seeing that, sooner or later, an operation for removing the tumor must be undertaken, the opportunity of removing it at once should obviously be taken advantage of.

A third question arises, applying equally to the more solid ovarian tumors as well as to solid fibroids, if immovable and not reducible in bulk. The danger now rises. There is obstruction to labor; there is the almost unavoidable risk of injuring the tumor. Malignant ovarian cysts may be firmly attached to the pelvic walls. Sarcomatous or bony tumors may spring from the pelvic walls, and fibroid tumors of the uterus may be impacted in the pelvis. Our decision as to the course to be adopted must be governed by a careful survey of all the conditions of the particular case. It is assumed that we cannot act upon the tumor. The alternative is, that *we must act upon the child or upon the uterus.* Should we determine not to try the Cæsarean section after Porro's method—that is, to remove the whole uterus, tumors and all—we must proceed to embryotomy. The mode of action will depend upon the degree to which the pelvis is contracted, and upon the estimate we may form of the nature of the tumor, and its liability to be injured by the passage of the child. If there remain three inches, or perhaps less, of space in the conjugate diameter, and the tumor be of a yielding substance, we may possibly deliver by forceps or by turning. If the space be very small, say under two inches, and the probability of the tumor being seriously crushed is great, we must be prepared to perforate the child's head to lessen its bulk and solidity. A perforated head will flatten and mould itself in its passage, especially under the cephalotribe; thus plastic and yielding, pressure against the tumor is greatly lessened.

In the case of a solid or comparatively firm tumor, leaving barely an inch or so of pelvic space, it may be difficult to reach the head to perforate; or, if perforation be accomplished, it may be impossible to pursue the further step of crushing the head by the cephalotribe, or of diminishing its bulk by allied operations. This is especially the case where lamination of the head by the wire-écraseur, as proposed by Robert Barnes, or by Tarnier's operation, promises to be useful. If we arrive at the conclusion that no amount of mutilation of the child that can be effected will insure delivery with a reasonable prospect of saving the mother, then we should spare the child and deliver it by the Cæsarean section. Great as is the peril to the mother of this operation, there comes a point at which it holds out the best chance. And to give the best chance we should endeavor to perform the operation as the first step—that is, by election—without having previously damaged the prospect of success by fruitless efforts to deliver by other means.

If the obstructing tumor be extrauterine, bony or semi-solid, and encroaching to an extreme degree upon the pelvic space, the argument for Cæsarean section will be strengthened. If the tumor be uterine-fibroid, the Cæsarean section must be carried out to the removal of the uterus after Porro's method. Dr. E. J. Lambert[1] collected fifteen cases in which the Cæsarean section, simple, was performed. Two women recovered; one operated upon by Mayor, of Geneva, and one by Duclos, whose case is cited by Tarnier.

When labor is obstructed by an extrauterine gestation, the case more especially calls for laparotomy, and that for a double motive; first, to deliver the uterine child; secondly, to remove the extrauterine child. Extrauterine gestation sacs so commonly contract adhesions with surrounding organs, that little can be expected from attempts to push them out of the way. We are, therefore, more disposed than in almost any other complication to resort to laparotomy.

[1] Etudes sur les grossesses compliquées de myomes utérins, 1870.

In the case of *solid tumors* the question of tapping, except for diagnostic purposes, will hardly arise. The rule in dealing with solid tumors may be stated generally as follows: Push them up and aside, if possible, unless you see your way clearly to remove them altogether. To enucleate a fibroid tumor from the uterus during labor is a hazardous undertaking, but circumstances may occasionally be favorable. Braxton Hicks relates[1] a case in which, finding the head arrested by a firm tumor so filling the vagina that delivery by forceps, turning, or embryotomy seemed doubtful, he made a small incision in the lower part of the tumor, which, under distention, permitted its enucleation and removal. There was no bleeding. The woman did well.

What is best to do in *the case of a myoma in utero after labor?* If it have been seated at the fundus, especially if projecting under the peritoneum, it may have escaped injury, and there may be no indication for treatment. But if the tumor have projected into the cavity of the uterus at its lower part, it will be likely to have suffered injury, leading to inflammation or gangrene. The uterus, still in a state of active muscular development and reflex irritability, resents the presence of the tumor as a foreign body. The expulsive pains set up are so severe as to be a source of danger; this we have seen strikingly marked. Cases in which spontaneous enucleation has been effected soon after labor have done well; cases left to nature have set up a low form of metroperitonitis, and have ended fatally. The indication, then, is strong to get rid of the tumor early. The mode of proceeding must be determined by the characters of the case in hand. The cervix, if closed, should be well dilated by a faggot of laminaria-tents; then a hernia, or other convenient knife, carried into the uterus, may be used to divide the capsule of the tumor freely. If the tumor project much into the uterine cavity, it may then be possible to shell it out, partly by the fingers and partly by Museux's vulsellum. Robert Barnes's axis-traction tumor-forceps has an excellent application here. If the tumor do not project much, and immediate enucleation be too difficult, further proceedings may be postponed.

The uterus, continuing to contract, may drive the tumor further into the cavity, and in a day or two its removal may be easier. This process and other indications will be materially promoted by subcutaneous injections of ergotine. Hemorrhage, if it occur, may be checked by injections of hot water, supplemented, if need be, by perchloride of iron. Fetor may be obviated by frequent injections of carbolized water or a solution of bichloride of mercury.

Summary of the Rules of Management of Labor complicated with Tumors.

Rising from the simplest cases to those of extremest difficulty, the general principles of practice are as follows:

A. Tumors complicating gestation. If the tumor, be it ovarian or uterine, encroach seriously upon the pelvic space, interfering with the due development of the uterus and threatening to obstruct labor: 1. Provoke abortion or premature labor. 2. If the tumor be ovarian, as a general rule, remove it. 3. If it burst or become strangulated, the rule to remove it is almost absolute.

B. Tumors obstructing labor—that is, presenting in front of the child: 1. Push the tumor above and aside if possible. 2. If the tumor be fluid, and it be thought better not to attempt its removal, tap it by aspirator-trocar. 3. If solid, puncture by aspirator-trocar, and if still not diminished in bulk,

[1] Obst. Trans., 1870.

remove it if possible by enucleation or by écraseur. 4. If the tumor cannot be advantageously acted upon, reduce the bulk of the child. Turn, perforate, crush the head by cephalotribe, reduce by lamination. 5. If neither tumor nor child can be advantageously acted upon *per vaginam*, resort to the Cæsarean section.

C. When the tumors present after the birth of the child: 1. If polypoid, remove as soon as possible after labor by wire-écraseur or galvanic cautery wire. 2. If sessile or projecting from the inner surface of the uterus, more especially if seated in the cervix or lower zone of the uterus, remove if possible by enucleation. 3. If they cannot be so removed, try to promote expulsion by quinia, ergotine, and watch to counteract septicæmia.

PROLAPSUS OR PROCIDENTIA OF THE UTERUS AS A CAUSE OF DYSTOCIA.—The uterus has been described as entirely procident outside the vulva during labor, at the natural term of gestation. To accomplish labor in such a case expulsion must depend upon the innate energy of the uterus itself. Complete procidentia in advanced pregnancy must be extremely rare. We may admit the possibility of the prolapsed uterus low in the pelvis becoming pregnant. There are no doubt cases of apparent procidentia uteri in which pregnancy has occurred. But we are not aware of any case in which it has been clearly demonstrated that the entire gravid uterus was suspended outside the pelvis and vulva. It has been said that the entire uterus containing the child has been driven through the vulva.

A curious case, which comes under this head, is cited by Moreau[1] from Chopart. A young woman had procidentia uteri, the result of violence before marriage. This was never reduced; but after twenty years, the cervix becoming gradually opened, conception took place. Labor at term went on for twenty-four hours without progress, when the child was dead and the woman seemed expiring. The surgeon, Marrigue, divided the cervix by incision and extracted the child. The woman recovered. There is a figure in Siebold's "Journal für Geburtshülfe," 1826, of a large mass outside the vulva with a foot projecting, but it is not certain that the whole uterus was outside. A more probable case is that of Portal, treated in conjunction with the first Moreau. A primipara had long suffered from prolapsus, but the uterus had gone up during pregnancy, and only came outside under violent straining in aid of slight labor-pains. The orifice was artificially dilated and a living child was extracted. Harvey relates a case of conception taking place in a procident uterus; a dead premature child was expelled.

THE TREATMENT.—Labor with simple prolapse is generally tedious, from the fundus wanting the full support and impact of the abdominal muscles. If the cervix be slow in dilating and the expulsive power be deficient, the cervix should be dilated artificially by the water-bags, and the forceps put on the head, care being taken to support the perineum and vulva well, lest the lower segment of the uterus be drawn through. In the case of complete procidentia—if such a case occur—the difficulty is aggravated; the uterus is away from all its auxiliary forces. Still its inherent power may possibly expel its contents. We should first endeavor to carry the uterus back into pelvis. If this fail, delivery must be effected outside the pelvis. Whether the uterus act by itself, or it be found necessary to extract the child by forceps or turning, it is desirable to support the lower segment carefully by means of a square cloth, having a hole cut in the middle large enough to afford exit to the child. This opening is applied over the os uteri, and the four corners are held up around the uterus, so as to counteract the downward

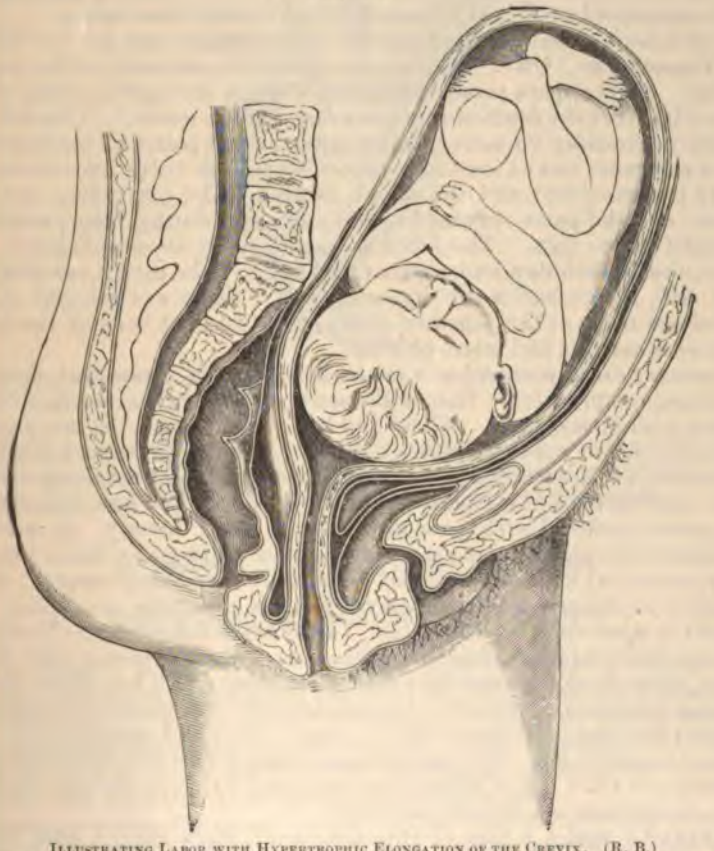
[1] Traité pratique des Accouchements, 1838.

ion applied to the child. Scanzoni says the long-continued bruising of terine walls against the pelvis may cause metritis or sloughing.

e have not seen a complete procidentia of the gravid uterus *at term*, but ave several times been called to see it. This is what we actually saw: normous fleshy mass protruded beyond the vulva, of livid color, and nting an opening—the os uteri—in its centre. On feeling the abdomen ave found at least a portion of the uterus, containing part of the fœtus, . It was clear, then, that, although the os uteri and cervix might be letely outside the vulva, the whole uterus was not. In one case, in which nidwife said the labor-pains "were forcing the woman's body out," we l the os uteri outside; and the finger passed three inches up along the cal canal till it was arrested by the os internum uteri, upon which the 's head rested. This condition is represented in Fig. 181.

ypertrophic elongation of the cervix uteri was the real condition in the cases referred to. It simulates closely complete procidentia on first appear-

FIG. 181.



ILLUSTRATING LABOR WITH HYPERTROPHIC ELONGATION OF THE CERVIX. (R. B.)
ead rests upon the os internum. The os externum is outside the vulva. The figure also shows the down-dragging and distortion of the bladder.

. In a subsequent labor the case sketched came under Dr. Roper. He d the same condition. The elongated cervix, then, was a persistent ition. In another case we found the head had passed along the hyper-

trophied cervix, and was protruding the os externum outside the vulva. In another the hypertrophied cervix was enormously distended with extravasated blood—cervical thrombus or hæmatoma—a condition to which the hypertrophied cervix is especially exposed. One cause of dystocia in these cases is the hardened state of the os and cervix uteri. Another case under our observation illustrates the influence of labor upon the hypertrophied cervix. A primipara, aged twenty-two, was in labor. The cervix protruded through the vulva about three inches, forming a mass equal to a man's wrist in circumference. After reducing the cervix within the vagina the head could be felt. The cervix had a hard, gristly feel. Free incisions in the os externum were made, so that the os externum was freely opened up to meet the natural expansion of the os internum. She was then delivered after an anxious labor of fifty-two hours. Two months after labor the cervix was found hanging down in the vagina like a piece of shrivelled skin. It was amputated. In dealing with cases of this kind, it is advisable to wait until expansion takes place above, that is, at the os internum, and then meeting this by incisions or mechanical dilatation from below. The complication is fairly represented in Fig. 181, designed from clinical observation.

Robert Barnes described and figured an interesting case in the "Obstetrical Transactions," 1876. The case occurred in the maternity of St. George's Hospital. A pluripara presented herself, when in the eighth month of gestation, with what she described as "protrusion of the womb." This had been gradually increasing for some months, causing much pain and bearing-down. The os externum was at least four inches outside the vulva; the cervix was greatly hypertrophied and the vagina everted. The protruding mass was reduced, and the parts remained *in situ* until and during labor, which was six weeks before term. The labor was quick, with no complication. She died on the seventh day, under signs of toxæmia. The cervix was elongated about 3.50 inches and much hypertrophied. There was a broad ring of ecchymosed tissue at the juncture of the crevix and the body of the uterus. There were metritis and metro-phlebitis.

Pregnancy in compartment of a two-horned uterus is a rare and, therefore, perplexing complication. Robert Barnes was called to a severe case of convulsions with albuminuria. There had been strong pains but no progress. Mr. Garlick, who was in attendance, could touch the presenting head; but Barnes felt a dense fleshy septum between the finger and the head, although it was clear that the finger passed into the os uteri. At last, following the clue given by Mr. Garlick, we also felt the head directly. It was thus ascertained that there were two ora uteri, each leading to a distinct uterine cavity, one of which contained the fœtus, the other being empty. It was necessary to deliver by craniotomy. Oldham describes a similar case.[1] Fig. 182 is taken from his illustration. Lefort cites a case from F. Tiedmann, who says there is in the Heidelberg Museum a double uterus with double vagina, taken from a woman who died after labor. At her labor two distinguished physicians attended; one declared the woman was not pregnant, the other that the head was in the os uteri. One had explored the right vagina, the other left. The same thing happened to two midwives at the Maternité, in 1824. The difficulty encountered by us, in the case narrated above, is therefore not without precedent.

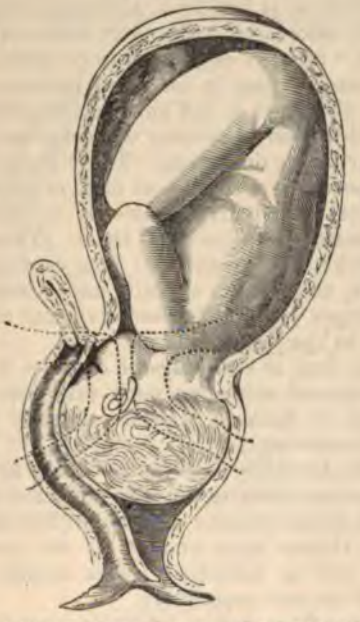
Birnbaum[3] relates a case of twin-pregnancy, there being a *fœtus in each side of a two-horned uterus*. A very distinct saddle-like depression was observed near the umbilicus, the upper boundary between the two horns of

[1] Guy's Hospital Reports. [2] Journ. Complem. du Dictionnaire, t. iv.
[3] Monatsschr. für Geburtsk., 1863.

the uterus. The summits of these rose to unequal heights. There was one placenta. He relates also a case of single gestation in one horn of a two-horned uterus. There is a valuable collection of cases illustrating this subject in "Kussmaul." (See, also, Barnes's "Diseases of Women.")

In some cases the septum is continued all the way down the vagina.

FIG. 182.



REPRESENTING GESTATION IN ONE UTERUS, A SECOND UTERUS BY THE SIDE UNIMPREGNATED. (After OLDHAM.)

There is then a double vagina as well as a double uterus (see Fig. 182). One vagina only is generally used in copulation. If labor be obstructed by such a septum, it should be divided longitudinally with a hernia-knife.

2. Dystocia from Faults in the Bony Canal.

Description of the Deformities of the Pelvis.

Deformities of the pelvis are mostly the result of disease or injury.

Stein, the younger, expounded the law that, like causative diseases produce like forms of pelvis. This fundamental proposition should be borne in mind when studying the different types of pelvic deformity. The origin and history of the development of the deformities observed are distinctly different, each type having its special origin and history.

Standing between the spinal column and the legs, the pelvis is subject to modifications imparted from each and both of these connected parts of the skeleton. It will bear the impress of faults existing in these parts in addition to the faults proper to its own structure. It may even be said that the derived deformities of the pelvis are the more numerous and important.

The principal types of pelvic deformity are: (1) The rickety pelvis; (2) the osteomalacic; (3) the kyphotic; (4) the funnel-shaped; (5, 6) the large

and the small pelvis = pelvis æquabiliter justo major and the pelvis justo minor; (7) the oblique-ovate of Naegelé; (8) the thorny pelvis = acanthopelys of Kilian.

Then there are distortions or obstructions due to bony, fibrous, or sarcomatous outgrowths from the pelvic walls, and distortions from fractures.

As, in the case of normal labor, it has been too much the habit to overlook the part played by the lumbar part of the spinal column, concentrating attention upon the pelvis, so it has been, although in a less degree, with difficult labor, too closely associated with pelvic deformity. There is no form of pelvic deformity in which we can afford to overlook the associated spinal condition. In some cases, indeed in many, of rickets, osteomalacia, spondylolisthesis, the spinal distortion is not only an important factor in combination with the pelvic distortion as causing dystocia, but it is an all-important factor in producing the pelvic distortion. There is, in fact, a form of lumbar or spinal distortion special to each typical form of pelvic distortion.

The truest and most instructive course is to describe the distortions according to the diseases which produce them. Thus, we should describe the distortions from rickets, the distortions from osteomalacia, the distortions from spondylolisthesis, those from syphilis and scrofula, not limiting the description to the changes wrought in the pelvis, but extending it to include the changes observed in the spinal column.

Barbour reminds us that, in studying the changes in the pelvis associated with the abnormally curved spine, we must take into account whether the pelvis itself is normal or diseased, since a deformity of the spine will produce different effects accordingly.

A. 1. We begin with *the rickety distortions*. These are of the most frequent clinical interest. Rickets, being essentially a disease of infancy, affects not alone the shape of the spinal column and pelvis, but also their development. Hence it is that the rickety spine and pelvis are commonly smaller in all their proportions, as well as deformed. This double abnormity intensifies the evils which flow from each separately.

The spinal deformities from rickets are two; lordosis, or arching forward, and, less frequently, scoliosis, or lateral curvature. The common effect of lordosis is to carry the sacral promontory forward, so as to lessen the conjugate diameter of the pelvis. The lordosis involves the upper sacral vertebræ. Thus the brim of the pelvis is narrowed in two ways: first, by the overhanging lumbar vertebræ; secondly, by the projection forward of the lower lumbar vertebræ and upper sacral vertebræ. This is designated by Robert Barnes the "false promontory." It alters the normal lumbosacral curve, or Barnes's curve, into the "curve of the false promontory" (see Fig. 185).

This lordosis is sometimes so great that it constitutes of itself an effectual barrier to the entry of the uterus and fœtus into the pelvis. When this occurs, the protrusion forwards of the uterus causes extreme prominence and overhanging of the belly. The effect is to throw the axis of the uterus and fœtus into extreme divergence from the axis of the pelvic brim. There is a remarkable example of this deformity in St. George's Museum. The woman died after craniotomy.

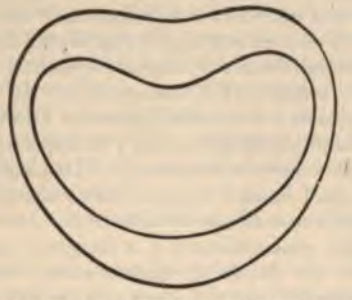
The influence of lordosis upon the pelvis is to narrow the conjugate diameter, to flatten the brim, and to produce relative expansions or loops on either side of the pelvis. The general shape, as compared with the normal brim, is seen in Fig. 183. This form of pelvis may be called the "lordotic pelvis."

When scoliosis occurs there is often oblique distortion of the brim as well as flattening. A perpendicular drawn from the symphysis pubis will strike

on one side of the promontory. Double or compensated scoliosis sometimes is not attended by pelvic deformity.

Rickets occuring in earliest infancy, before the component parts of the innominate bones have become fused, may lead to the *triangular or trefoil deformity*, somewhat resembling that produced by osteomalacia. Indeed, Hohl contends that rickets and osteomalacia are the same disease. There is a tendency, as development proceeds, to gain the normal shape. Hence we rarely find in the adult rickety pelvis a well-marked triangular deformity.

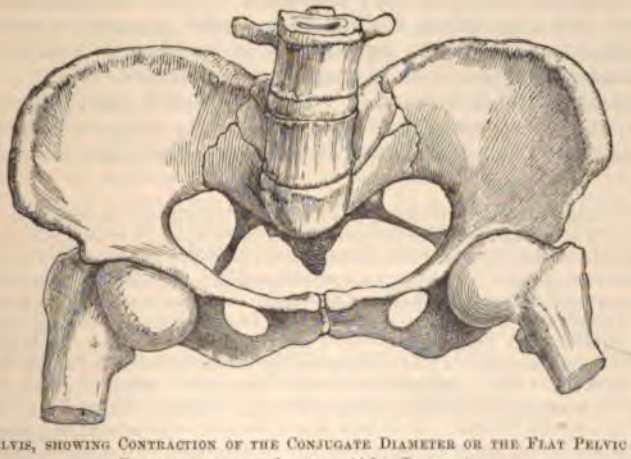
FIG. 183.



SHOWING RELATIVE SHAPES AND DIMENSIONS OF NORMAL AND RICKETY PELVES.

Fig. 184 is an extreme example of rachitic pelvis. The specimen comes from a dwarf upon whom Robert Barnes performed Cæsarean section after fruitless attempts at embryotomy, and irremediable injury had been inflicted. The pelvis is in St. Thomas's Museum. The specimen shows the tendency

FIG. 184.



RICKETY PELVIS, SHOWING CONTRACTION OF THE CONJUGATE DIAMETER OR THE FLAT PELVIC BRIM AND EXPANSION OF THE OUTLET. (After BARNES.)

of this deformity to divide the brim into two parts, one on either side of the projecting promontory, so that the available space is reduced to one of the loops of the figure ∞.

Deformities and contractions from rickets vary greatly in degree. The "simple flat rachitic pelvis" of Litzmann, the most common form, is often said to have its transverse diameter absolutely lengthened. In some speci-

mens the basis of the sacrum actually exceeds the normal width. Our own observations lead us to believe that actual excess of transverse diameter is rare. The transverse diameter is only relatively excessive. Thus, if we take, as is nearly always the case, the relation of the transverse diameter to the conjugative in the standard pelvis to be nearly as 9 : 7, we shall find the transverse diameter of the rickety pelvis in most cases not to exceed 8, and the relation of this to the conjugative will vary from 8 : 1, 8 : 2, 8 : 3, or 8 : 4. Contraction may be said to begin at ten centimetres, or four inches.

The rickety pelvis, as we have seen, is small generally; the narrowing bearing principally upon the conjugate, but affecting in less degree the other diameter also. Hicks has arrived at a similar conclusion. He has supplied us with measurements of ten rickety pelves in Guy's Museum. In two only of these does the transverse diameter measure 5 inches. That is the ordinary dimensions; whilst four measure 4.75 inches, three 4.50 inches, and one 4.25 inches only. The pelvis, as a whole, is lighter. The bones are rigid.

It is quite probable that deformities vary in kind and degree in different countries, as they certainly vary in frequency. In England the poorer classes are better fed, clothed, and housed than in most countries on the Continent, and the general hygienic condition is superior. In some districts on the Rhine and around Milan osteomalacia is a frequent result of the miserable conditions under which the laboring classes exist; whilst in England the disease is so rare that many men in large practice have never seen a case. On the Continent rachitis also seems far more frequent than with us.[1]

The influence of rickets is seen upon the innominate bones. They are generally smaller, thinner, sometimes diaphanous in the middle; and they are often flattened outwards, so that the crest of the ileum is straighter than in the standard pelvis.

The Germans recognize three principal forms of narrow pelves (see Litzmann and Spiegelberg): (1) The simple straight-narrowed or flat pelvis, the conjugate diameter being slightly shortened; (2) the uniformly contracted pelvis; and (3) a combination of the above, the generally contracted flat pelvis. These have a special significance, so that it is of practical importance to distinguish them from the other and much rarer forms.

The simple flat pelvis is the most common. Two forms of flat pelvis are seen: first, the flat, non-rachitic pelvis. The flattening is caused by the pressing downwards and forwards of the sacrum between the innominate

[1] This will account for the richness of the literature upon the narrow pelvis produced by our German brethren, and the meagreness of our own. It is the best answer that can be pleaded against the reproach addressed to us by Spiegelberg. If we cannot vie with the German school in writings upon the subject, it is because they write from abounding materials, which with us are wanting. But have we not done better? We have largely prevented those diseases which lead to deformity. The frequency of narrow pelves in Germany may be estimated from the following data: Michaelis and Litzmann found an average of 13 to 15 per cent., Schwartz between 22 and 23 per cent., Schroeder of 14.6 per cent., Spiegelberg about 14 per cent.; so that—citing Spiegelberg—nearly every seventh pelvis must be stamped as contracted. These figures are mainly deduced from hospital records. And here again the Germans possess the great scientific advantage of enjoying numerous opportunities of pursuing and completing their clinical observations in the dead-house. If we cannot approach the figures attained in Germany in the number of narrow pelves, neither can we in the mortality in childbed. Before the introduction of the Factory Acts, limiting the age at which girls can be employed in this country, deformed pelves were more common in our manufacturing towns. Radford informed us that within his time deformities had become much rarer in Manchester, and he attributed this in a great measure to the operation of these Acts. The improvement of the physical conditions of the laboring classes, aimed at the prevention of deformities, offers a splendid field for the beneficent application of German science.

bones; in short, its transverse axis being rotated. Thus the inclination is not increased, and the diminution of the conjugate diameter is inconsiderable, rarely falling below 8 centimetres, or 3.50 inches. Secondly, there is the rickety flat pelvis, contracted in all its dimensions.

The effect of rickets upon the pelvis below the brim is variable. The cavity and outlet are in many cases apparently expanded. Not that there is absolute increase of room, but the relative dimensions compared with those of the brim are larger. This difference is due to the excess of pressure bearing upon the brim during the development of the skeleton. There is often narrowing of the pubic arch, approximation of the tubera ischii, and sometimes incurving of the lower part of the sacrum and coccyx. Still, as a rule, in the rickety pelvis the sacrum at the upper part is straightened, and forms a plane running backwards, and the bones at the outlet diverge.

Hence two things follow: First, obstruction is most marked at the brim; secondly, there is generally space enough at the outlet and in the cavity for the obstetric hand, and therefore for operations upon the child.

The rachitic distortion is rarely symmetrical. One side of the pelvis is commonly narrower than the other.

The triangular pelvis with contraction is associated with rickets and scoliosis.

Narrowing of the pubic arch is not uncommon. It is sometimes associated with kyphosis. By throwing the child's head backwards it is apt to cause laceration of the perineum. It hinders the descent and rotation of the head, and often calls for the forceps. Another condition of the symphysis pubis is *undue height*. This carries the vulva and outlet of the pelvis so far backward as to be a great hindrance to coitus and to the progress of labor. The axis of the outlet is seriously deviated. This is not necessarily dependent upon rickets. The normal height is 4 centimetres, or 1.50 inch. Chantreuil measured one 7 centimetres, or 2.75 inches.

Diagnosis of the Rickety Pelvis.—The aspect of the subject is often characteristic. There is dwarfing of stature, prominent belly. Rickets may be suspected from the low stature and ungraceful gait. It is often attended by marks of imperfect development, and by spinal deviation. The sacrum is remarkably flat externally. On internal examination the tubera ischii may be felt a little converging, so as to narrow the outlet; but sometimes nothing unusual may be noticed at this part, but on pressing the finger backwards, its tip strikes the sacrum or its promontory, whilst the knuckle is perhaps applied to the arch of the pubes. In a healthy pelvis this cannot be done. The value of pelvimetry has also been referred to. No pelvimeter surpasses Van Huevel's. Its application is often of great scientific value. But we believe that in clinical work few surgeons of experience rely upon any instrument save the hand. This gives information that can be obtained in no other way. When there is obstruction, or retarded labor, or other cause to suspect pelvic contraction, the most practical course is to induce anæsthesia, and to pass the hand into the vagina. In this way we can explore the entire pelvis, take note of its various dimensions, and ascertain the relations of the fœtus.

In the minor degrees of rickety distortion, there may be no outward indication upon which to hazard a presumptive opinion. The difficulty comes before us at the moment of labor. Then, progress being obstructed, we search for the cause. We may then find flattening of the sacrum; external measurement between the lumbo-sacral joint and the symphysis pubis may give less than 7 inches. The distance between the anterior superior spinous processes and that between the crests of the ilia may be less than normal. But here again the only safe method is internal exploration by the hand.

If the finger easily touch the sacrum or promontory, and if the head be felt resting upon the pelvis, its vault expanding above the points of contact on the brim, we may assume that there is contraction and disproportion.

The following circumstances should provoke the suspicion that there is pelvic deformity: A protracted first stage of labor; slow dilatation of the cervix; premature rupture of the membranes; an unduly transverse position of the head, the forehead being lower than the occiput; an abnormal presentation; failure of the presenting part to enter the pelvic cavity, although the cervix may be dilated; approach to a pendulous belly, the fundus uteri being lower than usual, pointing more forwards.

Pelvic deformity may generally be recognized by the characters it imposes on the course of labor. As a natural pelvis governs the process of labor according to certain definite laws, so do the various forms of abnormal pelves, each in its own manner, control the process.

The mechanism of labor in rickety distortion will depend upon the degree of deformity. First, in the most extreme cases, in which the lumbar vertebræ hang over the pelvic brim, and the brim itself is narrowed to two inches or less in the conjugate diameter, the obstruction—always supposing a mature fœtus—is complete *ab initio;* the presenting part of the fœtus is simply shut out; it cannot enter the blocked pelvis. In this case there can hardly be said to be a mechanism of labor. Either the Cæsarean section must be resorted to, or the fœtus must be mutilated to bring it through the pelvis piecemeal.

In the case of the moderately contracted, flat, or rickety pelvis, the conjugate diameter being narrowed and the promontory projecting, the head can hardly enter the brim in an oblique diameter; it must almost necessarily present with its long diameter in relation with the long or transverse diameter of the pelvic brim. The anterior side of the head will, in the early stage of labor, overlap more or less, according to the degree of contraction, the symphysis pubis. The broader expanse of the occiput, not so easily entering the pelvis as the narrower sinciput, is delayed a little on the edge of the brim; thus the forehead will be at first driven lowest in the pelvic cavity. The driving force increasing up to a certain point with the resistance, the head is gradually moulded by being flattened in its transverse or biparietal diameter, inducing great overlapping of the frontal and parietal bones, so as to adapt itself to the flattened brim of the pelvis. The projecting promontory changes the direction of the axis of the brim, depressing it so as to bring it nearer to the horizon—that is, it is made to form, with the horizontal datum-line, an angle less than 30°. The lower end of this false axial line would fall, not upon the coccyx, but higher up, at some point in the hollow of the sacrum, whilst the upper end would fall below the umbilicus. There is increased inclination of the pelvis. The consequence of this is that the head must travel more directly backwards under the projecting promontory than when the pelvis is normal; it must, in fact, travel sharply round the promontory, doubling it in order to get into the pelvic cavity. The posterior side of the head is comparatively fixed against the promontory, whilst the anterior side of the head at first occupies nearly all the brim of the pelvis, the sagittal suture running across the brim and being much nearer the promontory than the symphysis pubis. In short, the asynclitism of normal relations is exaggerated in this form of abnormal labor. The head describes the first curve, "the curve of the false promontory," an exaggeration of Barnes's curve. Having got so far, the occiput usually descends and comes forward, and enters Carus's curve; this curve, too, is sharpened. The resultant parturient curve of the rickety flat pelvis is strongly marked. The figure (185) shows the extent of the departure from the "true parturient

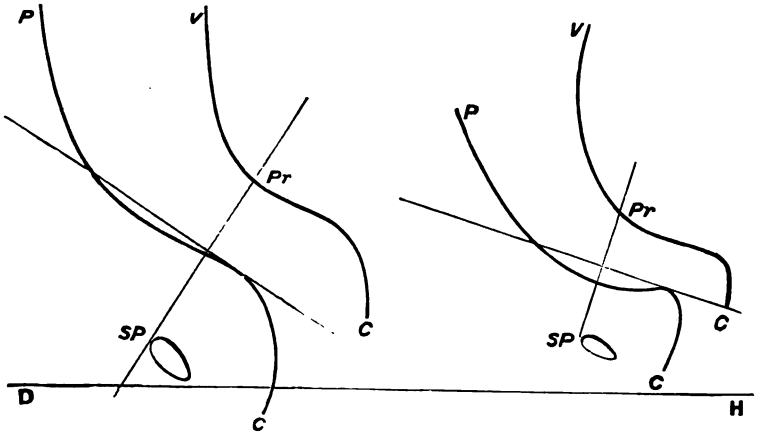
curve;" how both are governed by *VC*, the vertebral curve; and how the inclination and axes are changed.

The head is delayed at the brim. Litzmann found that in normal pelves the head had entered the pelvis before labor in 70 per cent., whilst in narrow pelves the head had entered in 18 per cent. only; also that with normal pelvis the head got into the pelvis in 24 per cent. before the rupture of the membranes, and with narrow pelvis the head descended into the pelvis in 56 per cent. after complete dilatation of the cervix.

Thus labor begins with a combination of unusual conditions.

One effect of the delay of the head upon the brim is that the lower segment or cervix of the uterus projects into the pelvis. Under uterine contractions, the head not being fixed, a larger quantity of liquor amnii is driven down, and the lower part of the ovum, filled with water and driven into the cervical canal, gradually stretches the cervix. This distending action is aided by the longitudinal shortening of the uterus. If the cervix be yielding, the bag of membranes unfolds it from above downwards in half-globular form; if the cervical canal offer more resistance, the fruit-sac, if its elasticity favor,

FIG. 185.



SHOWING THE COMPARISON OF THE SACRO-VERTEBRAL AND PARTURIENT CURVES IN NORMAL AND RACHITIC PELVES.

DH. Horizontal datum-line. *SP.* Symphysis pubis. *Pr.* Promontory. *VC.* Vertebral curve. *PC.* Parturient curve.

is pressed down more or less in the form of a cylinder through the os uteri Hence results frequent premature bursting of the membranes. This is due to the greater direct pressure of the uterine contractions upon the lower point of the fruit-sac. This is unfavorable to mother and child; a large quantity of liquor amnii escaping, the uterine and placental circulation is hindered, the head cannot expand the cervix quickly, and the orderly course of uterine action is prevented. There is unequal pressure upon the cervical ring, it bears unduly upon certain points; hence bruising, perhaps more serious injury. Similar injury threatens the vagina. Not seldom the obstructed circulation in the cervix and vagina from undue pressure leads to swelling of the soft parts, adding to the difficulty.

If the contraction of the conjugate diameter be more pronounced—that is, to about 3.50 inches—the first stage of labor will be more protracted still; the presenting part will remain for a longer time above the brim; the os uteri, wanting the dilating force of the liquor amnii and head, will be more

slow in opening; perhaps the cord will come down—and this is especially liable to occur if the membranes rupture early, since the head cannot block the brim. At length violent pains may force the head into the strait. The conditions already described will be observed in a more exaggerated degree. It is in these cases and in the preceding class that some additional force, applied *à fronte* by the forceps, is often valuable in economizing and supplementing the struggling *vis à tergo*.

In the still more contracted conjugate, where it is reduced to 3 inches or a little less, the head can hardly enter at all; it rests upon the brim, touching at two or three points only, therefore perfectly movable, except when fixed by the driving power; and there it will long remain unless its bulk be reduced. In these cases a marked indentation, even fracture of the frontal or parietal bone, caused by the long and violent pressure against the projecting promontory, has been noticed. This injury is not necessarily fatal. It is useful to bear this in mind, because in the event of the forceps having been used this might be assigned as the cause. We have known actions for damages threatened on this ground, even although mother and child have done well.

Blood-effusion on the brain may be caused, and occasionally the child suffers facial paralysis in consequence of pressure.

The mother is obviously exposed to all the perils of protracted and obstructed labor—that is, to exhaustion, lesions of the uterus, vagina, and bladder, hemorrhage, and puerperal disease. It is a generally recognized fact that in rachitic subjects successive labors become increasingly difficult. This fact is important to remember. Thus, a woman may be delivered of a live child without aid in her first labor, be delivered with difficulty by forceps or turning in a second or third labor, and be delivered by craniotomy in a subsequent labor. Such a history might be unjustly cited as a reproach to the obstetrist whose lot it is to encounter the advanced deformity or increased size of the child.

The Transversely Contracted Pelvis.

2. There are two forms: A. The two-sided synostotic, or double ankylotic, or Robert's pelvis. It is marked by narrowness of the sacrum, especially by the diminution of its wings, and ankylosis of both sacro-iliac joints. The sacrum is scarcely wider at the upper part than at the lower, and presents a long quadrangle. The whole sacrum is sunk deeply between the innominate bones, which rise above it behind; they are also stretched out forwards. The ischia approach each other and the edge of the sacrum; the transverse diameters are extremely contracted; the pelvis is generally somewhat symmetrical.

The most common cause consists in primary, congenital narrowness of the wings of the sacrum, either from inflammation attacking the already developed ilio-sacral joints leading to their ankylosis, or from defective development of these joints leading to synostosis. The prognosis is bad. Of eight cases six cases were delivered by Cæsarean section.

B. The Kyphotic Distortion.—Spinal kyphosis induces a peculiar deformity of the pelvis, called by Breisky[1] and Hugenberger[2] the "kyphotic transversely contracted pelvis;" by Michaelis, the "transversely contracted pelvis" ("das querverengte Becken"). Litzmann describes[3] a case. The most recent contribution to the subject is Dr. Barbour's beautifully illus-

[1] Med. Jahr. Wien, 1865.
[2] St. Petersburg, Med. Zeitung, 1868.
[3] Die Formen des Becken, 1861.

trated work on "Spinal Deformity in relation to Obstetrics," 1884. The illustration, Fig. 186, is borrowed from Hugenberger.

This form of pelvis resembles the pelvis of the lower mammalia, of the human infant, of the Bushmen, and Malayans of Java. It is interesting to compare Fig. 186 with the ideal scheme of the Andamanese pelvis (Fig.

FIG. 186.

KYPHOTIC PELVIS, SHOWING LENGTHENING OF THE CONJUGATE AND CONTRACTION OF THE TRANSVERSE DIAMETER. (After HUGENBERGER.)

58). The dimensions of the brim are reversed, the antero-posterior diameter being lengthened, and the transverse shortened. These altered relations are made clear by reference to Fig. 187.

The change of shape of the pelvis seems to be due to the kyphosis of the spine. The lumbar vertebræ retreating, arching backwards, carry the related

FIG. 187.

SHOWING COMPARATIVE OUTLINES OF BRIM OF STANDARD AND KYPHOTIC PELVIS.

upper sacral vertebræ back with them, thus effacing the promontory. It does not appear that this effacement increases the total capacity of the brim; the lengthening of the conjugate is gained at the expense of the transverse diameter. In a specimen in St. Bartholomew's Museum we find the conjugate diameter is 5.25 inches, and that of the transverse 4.50 inches, nearly. In

some Continental specimens the transverse narrowing is more marked than this. Where the disease begins before puberty, the development of the pelvis is arrested generally, the result being that the pelvis is small as well as distorted.

In one form the transverse diameter is not shortened, but the conjugate is much lengthened, as in a specimen in St. Thomas's Museum. Barbour found "the conjugate of the cavity increased, but to a less degree than at the brim. The sacrum is narrowed transversely and elongated vertically; its vertical curvature is diminished throughout. At the outlet the conjugate is not usually altered. The transverse *may* be contracted, and that to an extreme degree. The pubic arch is narrowed. Thus the true pelvis is funnel-shaped."

The upper half of the sacrum is rotated backwards and upwards; the lower half forwards and inwards. The innominate bones rotate from below inwards to upwards and outwards on an axis drawn through the hip-joints perpendicularly to the drag of the ilio-femoral ligaments, so that, under the resistance which these bands undergo in opposition to the drag of the sacrum backwards, the upper half of the innominate bones is moved outwards and forwards, the lower half inwards and backwards. Hence the increase of the transverse diameter of the great pelvis, and the diminution of this diameter in the cavity, and especially at the outlet of the small pelvis. The tuberosities of the ischia and the spinous processes come nearer together, and the pubic arch is narrowed. The small pelvis becomes deeper.

In some cases, as in one by Stadfeldt, cited by Spiegelberg, a lordosis of the lumbar vertebræ attends the kyphosis, with the result of forming a roof to the pelvis, as in spondylolisthesis, constituting the "pelvis obtecta."

The diagnosis is indicated by the stooping forwards of the body, the thighs projecting forwards, and by the recognition of the kyphosis. It is distinguished from other deformities, especially from the osteomalacic, by the great distance between the iliac spines, the flatness of the alæ of the innominate bones, and the difficulty in reaching the promontory.

The characters of the kyphotic pelvis are for the most part the inverse of the typical rickety pelvis. Most of the diameters which rickets diminishes are increased in kyphosis. In rickets the sacrum is driven down under the weight of the trunk; it is not so high; it has turned round, so that its base is carried down and forwards in nutation, whilst its point turns upwards and backwards. In the kyphotic pelvis the sacrum is erected, its base being carried backwards and upwards. The sacro-vertebral articulation is much above the linea innominata. At the level of this line is found the upper part of the second sacral vertebra. This articulation presents a certain relief, the two bones forming it making a jutting angle forwards instead of receding as in the normal pelvis.

Labor is obstructed at the beginning. The normal relation between head and pelvis is reversed. The Cæsarean section has been found necessary, although delivery could, we imagine, almost always be effected by embryotomy. The induction of labor is indicated. Hugenberger and Phænomenhoff remark on the greater frequency of occipito-posterior positions. This was the position in Barbour's case. We have long noted the frequency of occipito-posterior positions in connection with the funnel-shaped pelvis and flattened promontory, conditions which are now shown to indicate kyphosis. Champneys[1] analyzes thirty-two cases. He says right occipito-iliac position is much commoner than the left.

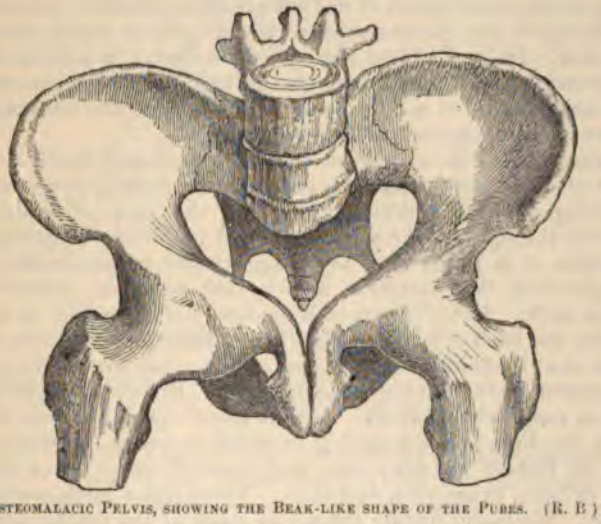
[1] Obst. Trans., 1883.

The Osteomalacic Deformity.

3. Osteomalacia = Mollities Ossium.—This disease, almost always arising after maturity, attacks bones fully developed. We saw, however, in the Munich Museum a specimen of intrauterine osteomalacia.

It produces a very remarkable deformity. This bears chiefly upon the spine and pelvis, the long bones being comparatively unaffected. The bones, losing their mineral constituents, become soft and yield under pressure. The pelvis and lumbar vertebræ, forming a compressible centre between the

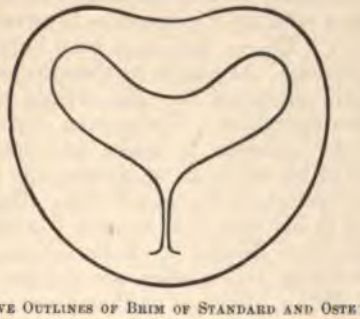
Fig. 188.



Osteomalacic Pelvis, showing the Beak-like shape of the Pubes. (R. B.)

upper part of the body and the legs, give way; all the bones sink inwards, collapsing concentrically. The spine falls downwards and forwards, squatting, the subject losing notably in stature. In many instances the lower lumbar vertebræ dip into the pelvic cavity. Specimens in St. Bartholomew's

Fig. 189.



Showing Comparative Outlines of Brim of Standard and Osteomalacic Pelves.

Museum and St. George's illustrate this in a striking manner. The heads of the femora drive in the acetabula and sides of the pelvis. In some cases the ilia are doubled up, folding in like wet pasteboard. The pubic bones

are flattened together by their posterior surfaces so as to form a beak or rostrum, so distinct that the finger and thumb can seize it through the living structures. The effect upon the brim is to produce the extreme cordate or trefoil shape, somewhat resembling the letter Y (see Fig. 189). The cavity and outlet share the general concentric compression, differing thus from the rickety distortion. There is really no pubic arch; the tubera ischii are closely approximated; the outlet is almost obliterated. The obstetric result is that in marked cases it is scarcely possible to introduce two fingers. There is little or no room for manipulation or for working instruments, so that we are commonly compelled to get at the fœtus from above by the Cæsarean section.

The concentric compression is not always symmetrical. In the Strasburg Lying-in Hospital are specimens in which one side is much more driven in than the other. In the Radford Museum, Manchester, is a specimen in which the promontory or last lumbar vertebræ actually touch the innominate bone. To study osteomalacia on a large scale, one must visit the German museums. The disease is nearly extinct in England.

The disease occurs in men as well as in women, but rarely. In a large proportion of cases the disease has been started during pregnancy or puerpery, affording another striking example of the value of studying general pathology by the light of the physiology and pathology of gestation.

Once begun, it is pretty sure to be aggravated in succeeding gestations. It seems probable that lactation acts by the waste of calcareous matter through the milk. But it occurs independently of gestation, as in a striking case forming the basis of a memoir by Bobert Barnes.[1] It seems to be almost endemic in the rice-fields around Milan, and in other places where the poorer class exist under every form of physical distress. But we have seen it developed in women in easy circumstances. It tells more especially upon the vertebræ and pelvis, the long bones escaping in great measure. Letheby examined the urine in Robert Barnes's case, and found 37 per 1000 of solid matter, consisting of urea, extractive, and salts. There was a large excess of earthy phosphates. We found during the active stage of the disease a large excess of urea, of alkaline and earthy phosphates, and extractive, almost constantly a little sugar, and sometimes a little albumen.

The obstetric relations are especially interesting. One important feature that distinguishes the osteomalacic pelvis from all other forms is its dilatability. Just as it undergoes concentric infolding by virtue of its softness, so it may be opened out again eccentrically under pressure from within. This property is occasionally turned to account in labor. Kilian[2] discusses this point, and relates a strikingly instructive illustration. Ed. Von Siebold wrote him this history: "Tr—— has long been burning with desire to perform the Cæsarean section. At length he thought he had a suitable case—a woman afflicted with osteomalacia. He invited his colleagues, amongst them Osiander, to the operation. The woman lay on the operating table, when Osiander begged permission to make an examination. He made it, and gradually passed in his whole hand, forcing the soft pelvic bones apart, turned the child, and brought it through living. He told Von Siebold next day, with tears of joy in his eyes, "Yesterday I saved a woman from Cæsarean section, and also from death."" Kilian, Von Ritgen, Hall, Spengel, Litzmann, and Tyler Smith relate cases proving the same point. The late Professor Lazzati, of Milan, informed us that his experience was to the same effect. It may, then, be taken as a fact that the pelvis is sometimes dilatable

[1] Med.-Chir. Trans., 1862. [2] Das halisteretische Becken, 1857.

enough to permit of delivery *per vias naturales*, and that this method demands trial before resorting to Cæsarean section or embryotomy.

It deserves to be borne in mind that osteomalacia may be arrested. Kilian says, "That osteomalacia *heals* is beyond dispute, but whether it is ever *cured* is altogether doubtful." Breslau and Litzmann give cases which recovered mainly under the use of cod-liver oil. Two cases under Robert Barnes recovered under the same remedy.

FIG. 190.

SHOWS COMPARATIVE VIEWS IN SECTION OF THE NORMAL PELVIS (THE STRONG LINE), THE OSTEOMALACIC PELVIS (THE FINE LINE), AND RICKETY PELVIS (THE DOTTED LINE).

THE FUNNEL-SHAPED PELVIS.—The peculiarity of this distortion consists in the brim being of fair proportions, whilst the tuberosities of the ischia and the sacrum converge, narrowing the outlet. We have met examples of it amongst the weavers of Bethnal Green and others who from childhood spent a great part of their lives in a sitting posture. Imperfect nutrition, no doubt, disposes to it. It is frequently referred to by the Dublin School. A marked case came under our care, the subject being a lady who exhibited no other mark of having suffered in health. Her first two children had been sacrificed by craniotomy; in the third pregnancy labor was induced at seven months; the forceps brought the head without difficulty to the outlet, when the disproportion became too manifest to permit a hope of its passing in this way. We turned, and delivered a child which survived.

This history is a fair clinical illustration of the process of labor in the funnel-shaped pelvis. The head may engage in the pelvis and descend to the floor, where it gets arrested; rotation is impeded. After allowing fair time for moulding, aided by compression of the forceps, it is found that the head cannot pass. It must be lessened in bulk by craniotomy, if we find that it cannot be brought through after turning. The funnel-shaped pelvis is one of the features of kyphosis. The *sacro-coccygeal joint may be ankylosed.* This produces an effect similar to the funnel-shaped pelvis. In such a case we may have to choose between lessening the head and forcible fracture of the ankylosis, to allow the coccyx to revolve backwards.

Spondylolisthetic Distortions.

4. Spondylolisthesis is the sliding down of the lumbar vertebræ upon the upper sacral vertebra. This gliding down throws two or more lumbar vertebræ into the cavity of the pelvis, producing a new and false promontory

in front of and lower than the true one. It not only contracts the conjugate diameter, but, by partly filling the pelvic cavity, prevents the uterus and child from entering.

The figure is taken from Kilian, who first described the distortion. The pelvis is in the Prague Museum. In another specimen described by Kilian, the false conjugate starts from the second lumbar vertebra, the third, fourth, and fifth having all sunk into the pelvis. Since Kilian (1853) attracted attention to this distortion, several important memoirs have illustrated it. The most recent and interesting are those of Neugebauer (1884) and Swedelin (1884).

Franz Neugebauer concludes from a critical examination of all the known cases—namely, 17 museum specimens and 26 in living subjects—that "the

FIG. 191.

SPONDYLOLISTHETIC PELVIS, SHOWING DISLOCATION INTO THE PELVIC BRIM OF THE LUMBAR VERTEBRÆ. THE "PRAGUE PELVIS." (After KILIAN.)

4. Fourth vertebra; 5. Fifth lumbar vertebra.

sliding of the vertebræ is a deformation always produced in extrauterine life, without the intervention of any primitive dyscrasia or disease of the bones, inflammatory or specific (that is, it is not rachitic, osteomalacic, caries, or osteitis). It is produced by the physiological weight of the trunk acting under the influence of certain surgical predispositions, especially when this weight is augmented by overloading the body, by repeated pregnancies, etc.; and this deformity is not limited to the sacro-lumbar articulation nor necessarily confined to age or sex."

In most of the cases observed there is simply a sliding down of the anterior half of the fifth lumbar vertebra—that is, of the half of the vertebra upon which the fourth lumbar vertebra bears with its direct weight; the posterior half of the vertebra keeps its place. Thus the vertebra is lengthened by dragging upon the anterior half. This lengthening is well marked in some cases.

Dr. Neugebauer demonstrated his views to the Obstetrical Society in 1884.

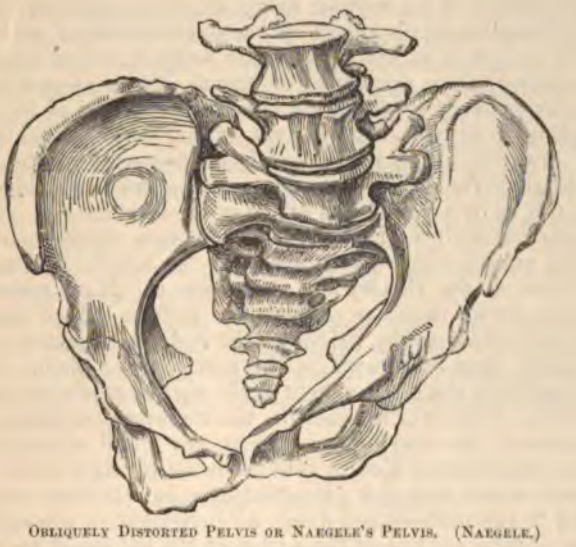
A committee, consisting of Neugebauer, William Adams, Noble Smith, A. Doran, and Robert Barnes, examined the specimens, and confirmed the accuracy of his conclusions. Neugebauer further discovered a characteristic specimen in the museum of University College. This specimen Dr. Graily Hewitt brought before the Society.

A case described by Robert Barnes[1] seemed to be caused by fracture. Neugebauer admits fracture as a possible cause. Spondylolisthesis obstructs labor by encroaching on the pelvic cavity. According to the degree, it may compel resort to craniotomy or the Cæsarean section. In our own case we brought on labor prematurely.

5. Distortion from Disease of the Pelvic Articulations.

(*a*) The *pelvis obliquè-ovata*, or the "schräg-verengtes Becken" of Naegelé. The illustration (Fig. 192) is taken from Naegelé's classical work. It is a fair type; but there are various modifications of this distortion.

Fig 192.



Obliquely Distorted Pelvis or Naegele's Pelvis. (Naegele.)

An essential condition of this pelvis is the loss of size or development of one side of the sacrum. In nearly all the cases the hip-bone of the defective side is pushed higher and backwards; in many cases the ilio-sacral joint of the affected side is ankylosed; there is one-sided synostosis. On the sound side the innominate bone is more strongly inclined, pushed outwards from the symphysis. The distortion is most marked at the brim.

The diagnosis is not difficult. The subjects are mostly deformed on one side. Measurements of the two sides of the pelvis will give different dimensions.

The effect upon labor is according to the degree of the distortion. If marked, the head cannot follow its normal movements. Craniotomy may be necessary.

(*β*) Another form of the obliquely distorted pelvis is that arising in young subjects having *one leg shorter* than the other, or ankylosis of one hip-joint. In such cases the lame side is less developed than the other side; the pelvis

[1] Obst. Trans., 1865.

is obliquely contracted; a perpendicular drawn from the promontory, which should represent the conjugate diameter, falls on one side of the symphysis. This distortion will disturb the relation between head and pelvis, and according to its degree necessitate forceps, turning, craniotomy.

The *acanthopelys*, or *Stachelbecken* of Kilian. This may be called the "thorny pelvis." Syphilitic, strumous, or rheumatic diseases may affect the bones of the pelvis, as they do the bones of the cranium and other parts. Sharp ridges or needle-like projections shoot up from the bones. The bones are also at times enlarged, spongy, thick, even distorted. The most frequent seat of these projections or outgrowths is the sacrum; but they may be found in any part. If ridges or spikes occur on the edge of the pelvic brim or on the symphysis, the uterus, forced down upon them, may be cut or stabbed in labor. We have seen a ridge formed on the linea ileo-pectinea so prominent and sharp as to give a knife-like edge. Probably in the syphilitic cases evidence of disease may be found in other parts of the skeleton as well, thus helping to a diagnosis.

With the history of the various forms of pelvic deformity before us, we may usefully note Duncan's theory of the development of pelvic deviation. He says the sacrum does not act like the keystone of an arch; it forms a strong transverse beam, suspended by means of the sacro-iliac ligaments, between the two curved cotylo-sacral beams; the weight of the body acts as a force tending to draw the sacral ends of the cotylo-sacral beams downwards and inwards, which movement is counteracted by the upward and inward pressure of the heads of the femora (on the cotyloid ends of these beams), as well as by the tie-beam of the pubic bones.

This theory was adduced to explain the changes which the normal pelvis undergoes in passing from the infantile to the adult type, and also such abnormal types as the rickety and malacosteon. More recent researches have, however, shown that the peculiarities in form, which were attributed by Duncan and others to the weight of the body transmitted in the manner described above, may be present in the pelvis before birth. Fehling, who has studied specially the development of the normal pelvis, has demonstrated that the vertical curving of the sacrum, the transverse widening of the brim, the incurvation of the cotylo-sacral beams, are found already in the fœtal pelvis. The researches of Kehrer into the mode of origin of the rickety type of pelvis have shown that this abnormal form is sometimes developmental. With regard to the malacosteon alone, all investigators are agreed that the peculiarities of form are due to the action of the weight of the trunk on the cotylo-sacral beams. The history of spondylolisthesis, in which the last lumbar vertebræ may be taken as the analogue of the sacrum in rickets, seems to tell against Duncan's theory.

Tumors growing from the pelvic walls may so encroach upon the pelvic space as to render the passage of the child difficult or impossible. These tumors may be bony exostoses, fibrous, sarcomatous, or cancerous. They most frequently spring from the sacrum. In the classical cases of Naegele and Shekleton, one of which is copied into nearly every text-book, the pelvis was quite blocked. The labors of the woman in Shekleton's case had become increasingly difficult as the tumor grew. This history enforces the indication to induce labor early enough to permit safe passage of the fœtus, and if the Cæsarean section is performed, to remove the uterus on Porro's method. We assisted Dr. Greenhalgh at St. Bartholomew's at a similar case. We could just feel a foot, but both failed to deliver. Mr. Skey performed Cæsarean section. The woman died. The pelvis was found filled by a sarcomatous tumor. In a case in which we were summoned to deliver by Cæsarean section, we succeeded in delivering after craniotomy. The woman recovered.

The tumor did not grow in a marked manner, and we saw her occasionally at the London Hospital for some years afterwards.

Berry relates[1] an instructive case of obstruction from medullary cancer springing from the bones of the sacrum. As it felt fluctuating it was punctured. A large quantity of florid blood flowed. After great exertions the child was delivered by craniotomy and turning, but the woman died in an hour. The uterus and vagina were found lacerated.

The diagnosis is generally not difficult. The uterus and child are obstructed above the pelvis. Examination by vagina realizes the blocked condition of the pelvic cavity; the vagina is compressed and distorted. By rectum the mass is more clearly defined; it is felt projecting the vaginal wall and closing the passage.

In cases of marked obstruction from immovable tumors in the pelvis, clinical experience points to the Cæsarean section as an elective proceeding. It is true that this operation, itself surrounded by great peril, may, even if successful, only give the woman a short reprieve. But this prospect is better for her than the imminent danger of speedy death attending attempts to deliver *per vias naturales*. Then there is the probability of saving the child; and this should turn the scale in favor of the Cæsarean section.

Distortion from Fracture.—Under violence sustained before or during gestation the bones of the pelvis may be fractured, and undergo repair with more or less deformity. The parts most liable to fracture are the alæ of the ossa innominata. If limited to the upper or false pelvis, the course of gestation and labor may not be seriously impeded. But if the framework of the true pelvis be broken, since it is almost impossible to secure accurate readjustment of the parts, distortion is most likely to ensue. This distortion must almost necessarily tell upon the cavity and brim of the pelvis, and thus cause an obstruction to labor.

The Split Pelvis.—"Das gespaltene Becken" of Litzmann. This is almost always associated with defective union of the abdominal walls and bladder. In Walter's case the symphysis was open, although the abdominal walls were united. The pelvis is flattened. A property of obstetric interest is that it is distensible.

Dystocia from the Fœtus.

A. Obstacles Occurring with the Healthy Fœtus.

(*a*) *Anomalies of Presentation and Position.*—It will be enough in this place simply to indicate them. The clinical history will be told when describing the operations. The breech or trunk may present in such a way that labor will be obstructed.

(*b*) The head may present with error of inclination, and there may occur faults in the movements of descent and rotation.

(*c*) There may be association of one or more limbs with the presenting part—that is, a hand may come down with the head; or there may be nuchal displacement of an arm—that is, an arm may hitch behind the neck.

(*d*) There may be excessive development of the fœtus in head, shoulders, or body. Several cases of children born alive at term weighing over 17 lbs., and even 20 lbs., are recorded. (See Neale's "Digest," and "Lancet," 1884, for one by Dr. Hodgson.) Ossification too much advanced may diminish plasticity.

[1] Obst. Trans., vol. vii.

The errors of position of the child may depend upon, or be associated with, errors of the other factors of labor, especially faulty pelvis.

(*e*) The umbilical cord may impede labor by being too short, or by getting twisted round the child's neck or body. In either case the descent of the child may be impeded, it being tethered to the uterus.

It is usual to class prolapsus of the cord under the head of dystocia. Strictly speaking, prolapsus of the cord cannot oppose a serious obstacle to labor, in so far as this means the passage of the child. But it endangers the child's life.

B. Obstacles from Pathological Conditions of the Fœtus.

The principal of these are hydrocephalus, hydrothorax, anasarca, ascites, distention of the bladder, emphysema, tumors on the surface of the body, deviations of the spinal cord, spina bifida, cystic or other enlargement of the liver or kidneys, ankylosis of the limbs, morbid attachment of the fœtus to the placenta or uterus.

Monsters not uncommonly cause dystocia.

Tumors on some part of the fœtus may present a serious and puzzling obstruction. Cystic tumors, the sac of a hydrorachis, ectopy of the intestines, parasitic tumors, as of a fœtus grafted upon some part. The cystic hygroma is most common on the sacral region. A remarkable example of sacral tumor is figured from a specimen in St. Thomas's Museum, in the "Obstetric Operations."

C. *Death or Impending Death of the Fœtus.*—In connection with this there may be emphysematous distention from putrefaction, or the rigor mortis may prevent the adaptations of the fœtus.

D. *Head of fœtus detached*, and remaining in utero.

E. *Multiplicity of Fœtuses*—(*a*) Fœtuses being in separate sacs, there may be wasted expelling force. (*b*) The fœtuses may be in one sac and get in each other's way. There may arise entanglement of the limbs or other parts of the fœtuses.

F. *Ectopic gestation* has been studied under "Tumors."

G. *Dystocia from Faulty Condition of the Placenta.*—The complications arising from placenta prævia and other conditions have been described under "Hemorrhage."

Clinical Classification of Cases of Dystocia.

The following distribution of the cases of dystocia according to their practical therapeutical indications will be found useful:

1. Disproportion or delay that can be overcome without injury to the mother and with probable safety to the child.

Dystocia arising in this way is met, (*a*) by increasing the *vis à tergo*, or driving force, by pressure on the uterus, or manual pushing-out of the child; (*b*) by putting on *vis à fronte*, or traction-force. Then the lever or forceps is indicated if the head present, and turning or traction by hand if the arms or breech present.

2. Disproportion that can be overcome without injury to the mother but with sacrifice of the child. The treatment indicated is to reduce the bulk of the child by perforator, crotchet, cephalotribe, cranioclast, forceps-saw, écraseur, basiotribe.

3. Disproportion beyond either of the preceding cases, but to be overcome

with possible or probable safety to mother and child. This demands the Cæsarean section in its various modifications.

This classification is essentially clinical. The diagnostic differentiation of the classes of cases does not necessarily demand a precise recognition of the exact causes of the disproportion and difficulty. The preceding analysis of these causes, according to the factor affected—that is, the soft parts, the pelvis, or the fœtus—is essentially scientific and abstract. This scientific analysis, again, differs from the clinical analysis in this: in the latter, two or more of the causes described in the scientific analysis may, and frequently do, act in combination. One alone might not produce dystocia in a serious degree; but two or more of them, each by itself insufficient, may, by accumulating or exaggerating action, produce serious dystocia.

This clinical survey of dystocia must be read in connection with the symptomatology or history of dystocia, given at the introduction of the subject.

When labor is obstructed, one of two conditions of the fœtus occurs. It is either *impacted* or *arrested*. What meaning is attached to these terms? The fœtus may be stationary from simple arrest or from impaction. *Arrest* is due to want of expelling power, or to some hitch from failure of accommodation of the fœtus to the particular part of the passages in which it is placed. The fœtus may be arrested in cases where both pelvis and fœtus are of normal proportions. It may also be arrested in cases of disproportion, due to excessive size of the head or very narrow pelvis, or from malposition, so that the presenting part of the child cannot enter the pelvis, but rests upon it, movable.

Impaction, on the other hand, arises when the head or other presenting part is jammed in the pelvis, wedged in so that it cannot advance nor be easily pushed back. There is, as the French call it, "*enclavement*." This condition arises when the pelvis is contracted, but is open enough to admit the fœtus a little way; it occurs in arm-presentations; even when the pelvis and fœtus are normal, the child is wedged.

The *signs of the fœtus being in danger* are convulsive movements or twitchings of its limbs. These are indications of impending asphyxia. The heart flagging, as ascertained by auscultation and feeling the cord: then pulse ceasing; voiding meconium. These signs indicate urgency to deliver in the child's interest; and this is rarely manifested without there being at the same time expediency, at least, to deliver in the interest of the mother.

CHAPTER XXVI.

FORCEPS.

GENERAL PRINCIPLES RULING OBSTETRIC OPERATIONS. THE FORCEPS; ITS POWERS; RULES GOVERNING ITS USE; APPLICATION IN OCCIPITO-ANTERIOR POSITION OF HEAD, IN OCCIPITO-POSTERIOR, FACE, AND BROW; OVERHANGING BELLY; AFTER-COMING HEAD. DANGERS ATTENDING USE OF FORCEPS.

The Operations.

General Discussion of Obstetric Operations.

THE instruments—including the master-instrument, the hand—have been described in the chapter on the "Armamentarium Obstetricium." We have now to study the application of those instruments, the indications for their use, and the modes of using them.

Certain general principles govern obstetric surgery. The first, and most important of all, is to accept as our guide in every operation, as nearly as possible, the processes adopted by Nature in ordinary labor, and this rule applies with peculiar force to delivery by turning and by the forceps. In these operations the duty of the surgeon is to help Nature, not to supplant her. She is rarely utterly at fault.

Another principle of action is to ponder well whether we can save both mother and child. Turning and the forceps are generally designed to accomplish this twofold good result. This is the highest and most gratifying achievement of conservative obstetrics.

The next principle is, when we are compelled to abandon the hope of saving mother and child, to do our utmost to save the mother. It is told of the great Napoleon, that when the question was put to him, in the case of his wife in labor, he, anxious as he was for an heir—a dynasty at stake—answered, "Save the mother; it is her right." To save the mother, even at the sacrifice of her child, is the plain duty of the surgeon.

Next comes the question, when the case of the mother is hopeless, how to save the child.

Lastly comes the question, having, either through experience of past labors or from recognition of danger during gestation, arrived at the conclusion that the safety of mother or child, or of both, is imperilled by letting gestation go on to term, whether we cannot by art avert threatening evil, by bringing the gestation to a premature conclusion. This operation brings us back to the highest aim of conservative obstetrics.

A lesson drawn from the above propositions is, that we trace in their successive applications the guide to a scale of operations. There is a progressive advance from the saving or conservative operations to the sacrificial operations. The operations stand in a series rising in severity. From the forceps and turning we pass to embryotomy and the Cæsarean section; and then, retracing our steps, we resort to the induction of labor.

A general idea of the indications which guide in the selection of opera-

tions, in so far as dystocia depends upon pelvic distortion, may be derived from the following

SCHEME OF RELATIONS OF PELVIC CONTRACTIONS TO MODES OF DELIVERY AT TERM; CHILD'S HEAD ASSUMED TO BE NORMAL.

Conjugate diameter reduced to	Operations at term.	Operations at seven months.
4 to 4.25 in.	may end in natural labor.	
4 to 3.75 in.	" " forceps or turning	Natural labor.
3.75 to 3.50 in.	" " turning	Forceps.
3.50 to 2.25 in.	" " craniotomy	Turning.
2.25 to 1.75 in.	" " craniotomy doubtful, Cæsarean section	Craniotomy.
		Cæsarean section eliminated.

Taking the same measurements *in labor at seven months*, by sliding down the scale of operations, as in the third column, we find that natural labor takes the place of forceps, forceps of turning, turning of craniotomy, craniotomy of Cæsarean section; and thus the Cæsarean section is eliminated.

In this table there is seen some overlapping in the application of the various operations. It is obviously impossible to construct rigid, absolute rules. Other factors besides that of mere pelvic narrowing commonly enter into the case.

The choice of the operation in any particular case is too often determined by the accidental and relative perfection of or familiarity with particular instruments. And so, it may be added as a corollary, will be the result to mother and child. Thus, a man who has only reached that stage of obstetric development which is content with a short or single-curved forceps, will be armed with more or less efficient perforator and crotchet. He persuades himself that the case is not a fit one for the forceps, and so resorts to the easy but sacrificial operation of craniotomy. Or if he have been accustomed to use a comparatively short double-curved forceps like Simpson's, which will mostly fail to seize the head at the pelvic brim, he may resort to turning, an operation vastly more dangerous to the child; or to craniotomy, which destroys it.

At the present day we may boast of having good and efficient instruments of all kinds, each capable of doing excellent work in its own peculiar sphere, and, moreover, endowed with a certain capacity for supplanting its rival instruments. For example, the long double-curved or the triple-curved forceps is adapted to supplant craniotomy in a certain range of cases of minor disproportion. Hence it follows that it is of more importance to have a good forceps which can save life, than it is to have a good perforator which destroys life. At the same time it is eminently desirable to possess the most perfect means of bringing the fœtus through a very narrow pelvis, in order to minimize the necessity of resorting to the Cæsarean section. Our aim, then, should be to perfect all our instruments, to make each one as good of its kind as possible.

And first, and above all, it is necessary to cultivate to the utmost the master instrument, the hand. Many of the most difficult and beneficial operations are performed by the hand alone. Obstetric surgery has this peculiarity: its operations are carried on the dark, our only guide being the information conveyed by the sense of touch. The mind's eye travels to the finger's ends. The hand is a diagnostic as well as a surgical instrument. The hand thus possesses an inestimable superiority over all other instruments. Its every movement is regulated by consciousness. Even more than instruments vary does the obstetric hand. Care and experience will to some extent

improve the most clumsy. But just as a bad forceps cannot be made to do the work that a good one will easily accomplish, so the originally awkward hand will never attain to the skill of the master.

THE POWERS OF THE FORCEPS.—The first point in the study of an instrument is to determine what it can do. We find that the powers inherent in the forceps are three. Thus, applied to the child's head, it is endowed: (1) with the power of compression—that is, of moulding the head; (2) with the power of traction; (3) with a leverage power.

1. *Compression.* The child's head, as we have seen, is moulded under the normal pressure which it undergoes in its transit through the pelvis. This plastic property is an essential condition of accommodation. Either because the natural force is unable to propel the head in such a manner as to bring it within the range of the moulding factors, or from other causes, the forceps, by drawing the head down within this range, acts on the most strictly physiological principle.

The compression is effected in two ways: (1) By the direct compression of the head between the blades by pressure upon the handles; and (2) by the pressure exerted upon the bows of the blades by the resistance encountered in the passages as the head descends. This pressure serves to fix the blades upon the head, and thus the head is further compressed and moulded by the medium of the forceps. Thus the forceps aid Nature.

Different forceps vary greatly in the degree in which this property of compression is possessed. The old short single-curved forceps, with short handles, possess very little compressive force. What they do possess is due almost entirely to the pressure exerted upon the bows of the blades by the resistance of the passages.

Some even of the better models of long double-curved forceps owe their compresssive power upon and grasp of the head to the same external pressure upon the bows. No matter how firmly the handles are gripped by the operator, it will be found with most English forceps that as soon as the equator of the head clears the pelvic outlet, the blades, losing the external support, are apt to slip off. The shanks are commonly made so slender that, when the handles are tightly gripped, the blades adjusted upon the head find this globe too resisting to yield beyond a very small extent, and so the blades open a little—that is, the instrument "springs."

This fault—or advantage, according to the view taken—is not found in the French forceps, the branches of which are made stouter, and therefore spring but little, if at all. These forceps, therefore, grasp and mould the head in great measure through the leverage applied to the handles.

An interesting question, but one difficult to answer with precision, is: What is the measure of the compressibility of the head, compatible with safe delivery? Numerous experiments have been made upon dead children to determine this point. Baudelocque found that he could lessen the transverse diameter by a quarter to a third of an inch. Siebold gained half an inch. Osiander and Velpeau claim as much. Joulin and Chassagny proved that a degree of moulding still greater may be attained. But these experiments upon dead children are of doubtful application to the solution of the problem. The important clinical fact is that in many cases the child survives, although its head has undergone very great compression and moulding. The degree of compressibility compatible with life is probably a variable quantity. The following conditions influence the result: the degree of development of the head as to size and ossification, and the mode in which the compressing force is applied. If the force be applied *gradually and intermittently*, a much greater degree of moulding with less injury to the child may be obtained than what Baudelocque thought possible. The clinical experiment observed in the

natural process of moulding indicates approximately the extent of compression that may be obtained with safety, and the conditions under which artificial compression should be applied.

Thus we have seen that the biparietal diameter of 4 inches may be reduced by the natural forces to 3.50 inches. But this gain could not be made by rapid forcible compression between the rigid blades of the forceps without endangering the child's life. The forceps must therefore be used slowly and intermittently.

This rule seems good both in logic and in physiology, but experience proves that there are cases where the head-moulding can be accomplished more quickly with safety by continuous pressure. Delore,[1] who has made many dynamometric observations, concludes that pressure, exerted either by the forceps or the genital organs, may be harmless to the head if spread over a large surface. It is limited and angular pressure that is dangerous. He also established the rule that *the greater the traction the greater is the pressure.* The pressure is equal to about half the traction. Thus, if we exert a traction-force of fifty pounds, the pressure upon the head is about twenty-five pounds. These observations, again, illustrate the proposition already stated, that grasp and compression are greatly due to the pressure of the passages upon the bows of the forceps. It is necessary to remember that experiments of this description, made before the axis-traction forceps was used, are open to the fallacy that the traction almost necessarily involved some waste force by the vicious direction imparted to it.

2. The *traction power.* This is the most obvious property. It cannot well be dissociated altogether from, 3. The *leverage power.* It is more instructive to study these two forces together. The forceps is a double lever; each branch is a lever and might be used as such separately; united, each branch acts as a fulcrum to the other. The lever application of the forceps is strongly denounced, but we think for want of right understanding of the question and want of delicacy of touch. It is simply a mechanical impossibility to pull with absolute unvarying straightness upon a rope or rod; some degree of oscillation is unavoidable; the best trained muscles, acting against considerable resistance, will sway a little. This is leverage, and the degree of leverage increases with the length of the rod—that is, of the forceps.

Leverage is a force indicated by Nature; it is a most important factor in the natural progression of the head. As the head advances, first one side of the head is felt a little lower than the other; presently a slight oscillation of the head on its long axis is perceived during its screw-movement, the side that was at first highest coming down a little. The adaptation of the head to the planes of the pelvis is largely effected in this manner. Since it is our business to help Nature by imitating her, it would be folly to reject this force.

The question then remains, how best to use this force? The reply is, not by violent oscillations, carrying the handles first strongly to one side, then over to the other; not by making a fulcrum against the sides of the pelvis at the risk of crushing the soft parts, perhaps of opening the bladder; but by gentle, almost imperceptible, alternate movements, traction force being exerted at the same time, and making the blades of the forceps act as mutual fulcra, or by making a fulcrum of the forefinger.

We are in the habit of demonstrating the safe and effective leverage of the forceps by using each blade alternately unlocked, making the finger serve as a fulcrum. In this way, in an ordinary case, the head may be seen and felt to descend as first one side of the head, then the other, is canted downwards. This is done without any traction force whatever; it is, in fact,

[1] Gazette hebdomadaire, 1865.

the illustration of the action of the simple lever, an instrument now comparatively obsolete. If the simple lever be now neglected in favor of the more efficient double lever, it is at least worthy of remembrance for the lesson it teaches that its power is transferred to the forceps. Indeed, one of the earliest attempts, stimulated by the desire to realize the concealed discovery of the Chamberlens—that of Palfyn—consisted in applying two opposed levers which did not cross, and therefore could not exercise any direct compressive action. Assalini's forceps is the surviving representative of this principle. Its two opposed blades do not cross; its compressive power is due to external pressure upon the fenestræ; and its prehensile and traction power is due to the curvature of the blades upon the head.

The traction power obviously depends in the first place upon a good hold. This we have seen is effected partly by the outward pressure upon the fenestræ and partly by the curvature of the fenestræ embracing the head. This curve is more marked in the French forceps than in most of the English instruments, and in this we think the French forceps is superior.

Four rules should govern the use of the forceps: 1. The direction of the traction must be the axis of the pelvis. This has been demonstrated in describing the axis-traction forceps of Aveling and of Tarnier. Traction so applied, aided by 2. Slight lateral or oscillating movement, reduces the force required to the minimum, and this means the minimum of violence to the mother and the child, and, in some difficult cases, successful delivery beyond the power of ordinary instruments. 3. Give time for the head to mould and for adaptation to be effected. 4. Aid the *vis à fronte* by putting on *vis à tergo*. This is done by a binder or the hands of an assistant pushing the head into the pelvis. In this way traction force to the extent of 5 lbs. to 7 lbs. may be saved. The child's trunk is kept with its axis coincident with that of the pelvis; this implies a saving of compressive force, and lessens risk of injury from stretching the child's neck.

We add a negative rule admitting of few exceptions: Avoid using the forceps to rotate the head; this rotation should be left to the natural law of adaptation.

Knowing the power we hold in the forceps, we may now study how to use it.

Postulates for the useful Application of the Forceps.

1. The os uteri must be dilated, or dilatable enough to permit the blades to pass without stretching. To this rule there are some exceptions.
2. The fruit-sac must have burst. It is not necessary to wait for the evacuation of liquor amnii. Sometimes the uterus is paralyzed by the head acting as a ball-valve; one blade then introduced gives a channel for the escape of the damned-up waters.
3. The pelvis should be of normal proportions, or only contracted in the minor degrees.
4. The head should be normal in size and firmness.
5. The bladder and rectum should be empty. We recommend to carry a catheter tied to the forceps, so that on taking up the instrument we are at once reminded first to use the catheter. Neglect of the state of the bladder has undoubtedly led to serious catastrophes.
6. Ether-narcosis is especially useful in the high operations.

Indications for the Use of the Forceps.

It may be premised as a general rule that if the forceps lock easily the conditions are favorable.

ding from the simple to the more difficult cases, we may divide the ases in three classes:

E HEAD IS IN THE PELVIC CAVITY.—This is the *low operation.* (*a*) simple arrest. (*b*) Arrest from persistent capping by the anterior alve (see Fig. 113). (*c*) Arrest with slight impaction from disproporunyielding state of the soft parts. (*d*) Arrest on perineum in an or transverse position, driving force wanting to rotate the occiput . (*e*) Arrest from occipito-posterior position. (*f*) Arrest from vicious of the driving-force, from non-coincidence of the axis of the uterus axis of the pelvis, as with overhanging belly.

st of the above cases the short, or so-called straight, forceps might able, but the long forceps is better.

rrest in the pelvis, the trunk being delivered—*head-last labor.*

E HEAD PARTLY ENGAGED IN THE PELVIC BRIM.—This is the *medium* . (*a*) There is arrest from defective driving-force, (*b*) Arrest from t dilatation of the cervix. (*c*) Arrest from slight excess of child's inor degree of impaction. (*d*) Arrest from slight projection of the ory, so that the head is kept in the transverse position. (*e*) Arrest e-presentation: (1) impaction, chin forwards, occiput compressed ucha in strong extension; or (2) chin remaining backwards, impacn wedging of head with back of child.

E HEAD ARRESTED ON THE PELVIC BRIM OR ONLY SLIGHTLY EN—The *high operation.* (*a*) Arrest from want of driving-force, inherent emotion, excessive distention of uterus from liquor amnii or twins. st from non-coincidence of uterine axis with pelvic axis, as in over- belly or marked obliquity of the uterus. (*c*) Arrest from minor f disproportion, head larger or pelvis small.

ne of these cases the forceps are used tentatively. If the case proves le to the forceps, turning comes next.

general terms, the forceps may come into requisition for low, medium, peration, to save from lingering labor, and in cases in which delivery ted apart from disproportion or malposition. (1) In the interest of er: (*a*) Some cases of hemorrhage; (*b*) convulsions; (*c*) to obviate on and uterine paralysis from protracted labor; (*d*) to obviate g of vagina, vesico-vaginal fistula, and rupture of the perineum. he interest of the child, the mother being *in extremis.*

ne of the cases specified, turning or craniotomy comes into competi- n the forceps—first, as elective; secondly, as alternative operations. iscussion "On the Uses of the Forceps and its Alternatives in Lin- abor," introduced by Robert Barnes in the Obstetrical Society, in following propositions were submitted and met with general approval: be premised that the alternatives are waiting or expectancy, ergot ning. 1. In lingering labor, when the head is in the pelvic cavity, ps is better than its alternatives. 2. In lingering labor, when the ngaged in the pelvic brim, the pelvis being known to be well formed, ps is better than its alternatives. 3. In lingering labor, when the resting on the brim, the liquor amnii discharged, and it is known, y exploring with the hand or by other means, that there is no dison or only a slight degree of disproportion, even although the cervix lly dilated, the forceps will generally be better than its alternatives. oportion as the head is arrested high in the pelvis, in the brim, or he brim, the necessity, the utility, and safety of the forceps become ubtful. 5. As a corollary from the preceding proposition, increasing in determining on the use of the forceps and greater skill in carrying operation are called for.

Dr. McClintock regarded it as one of the most generally true maxims in midwifery that as long as the membranes are entire and the liquor amnii present, no danger will accrue to mother or child by the continuance of the labor process, except from convulsions or hemorrhage. But this requires some qualifications. Certainly, lingering labor involving the risk of exhaustion or rupture of the uterus may arise before the rupture of the membranes.

Modes of Applying the Forceps; the Operation.—The first thing to determine is *the posture* of the patient. We have to choose between the left lateral and the dorsal or lithotomy posture. In this country the almost universal practice is to draw the patient to the right edge of the bed, placing her on the left side, the knee well drawn up. In France the dorsal posture is preferred. The patient is brought to the edge of the bed, lying on her back, with the knees raised and flexed, and supported by assistants. Each method has its advantages. National customs will probably be adhered to. In favor of the English custom it may be pleaded that it involves much less

Fig. 193.

First Stage of Introduction of First Blade. (R. U.)

disturbance of the patient, that it requires no second assistant, and that it is for these and other reasons more convenient in home practice. On the other hand, the dorsal posture is more favorable to maintaining coincidence of the uterine and pelvic axes, to support and compress the uterus by the hands of an assistant supplying *vis à tergo*, and to give more power and nicety of action to the operator during the last stage of extraction. The student should practise under both conditions on the phantom.

Selection of Instrument.—We will not encumber the subject by describing the mode of using the short forceps. As the greater includes the less, all that can be done by the short forceps can be done better by the long forceps; and he who can work with the long forceps will find no difficulty with the short.

Anæsthesia is not necessary, but may be called for. As in other surgical operations, the induction of anæsthesia should, if possible, be entrusted to a special assistant. The conduct of the operation is enough for the surgeon. Pass the catheter.

The forceps operation may be divided into four stages or acts: (1) The introduction and adjustment of the blades; (2) locking; (3) compression, traction, and leverage; (4) removal of the instrument when the head is born.

The blades should, in strict theory, be so applied as to seize the head in its biparietal diameter. This rule is insisted upon by Tarnier; but in practice this is often difficult of attainment. The pelvic curve of the long forceps practically determines the placement of the blades in accordance with the curve of the pelvic canal; thus, the blades naturally run into the sides of the pelvis, and grasp the head as it is found. It is true that the usual oblique position of the head will to some extent deflect the blades towards the biparietal diameter. The combined effect of these two factors will be to produce an oblique adjustment of the blades—oblique both as regards the pelvis and as regards the child's head.

FIG. 194.

SECOND STAGE OF INTRODUCTION OF FIRST BLADE. (R B.)

In the great majority of cases, if the position of the fenestræ and the marks made by them on the fœtal head be observed after delivery, it will be seen that one fenestra was applied more or less behind the transverse diameter, and the other a little in front. The recognition of this fact much simplifies and facilitates the use of the instrument.

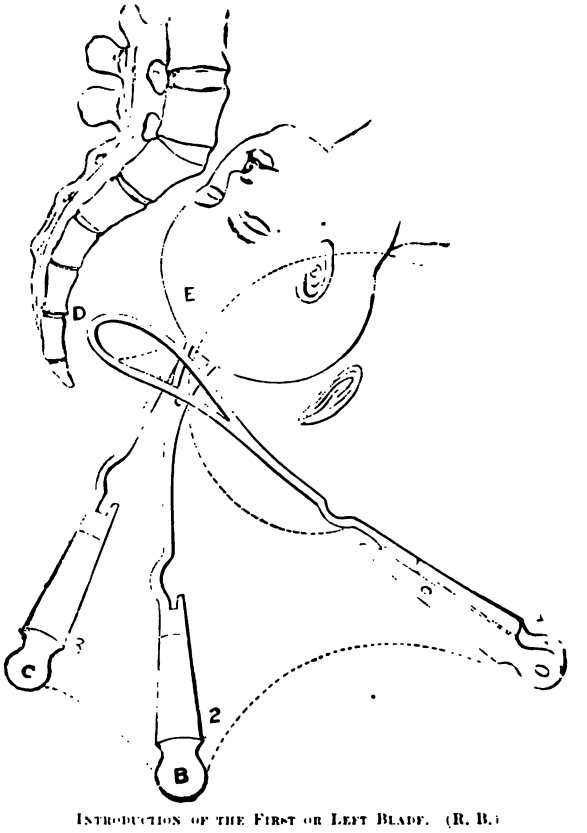
THE APPLICATION OF THE FORCEPS IN OCCIPITO-ANTERIOR POSITIONS WHEN THE HEAD IS DELAYED ON THE BRIM.—The left lateral decubitus is assumed.

1*st Act.*—Dip the blades in warm water, wipe them dry, and lubricate with carbolized vaseline. To select the blade to introduce first, join the blades, and holding the instrument with the concavity of its pelvic curve forwards, the blades in the position they are to occupy in the pelvis, take that one first which is to lie in the left or lower side.

One or two fingers of the left hand are passed in at the perineum (see Fig. 193), taking care to get them between the cervix uteri and the child's head. Then, bearing in mind the relative forms of the instrument, the head, and the pelvic canal, the point of the blade is passed along the palmar aspect of the fingers, at first nearly directly backwards towards the hollow of the sacrum.

2*d Act.*—The handle is now raised, so as to throw the point downwards upon the left side of the head. As the point of the blade must describe a

FIG. 195.



INTRODUCTION OF THE FIRST OR LEFT BLADE. (R. B.)

1. First stage, or introduction of point of blade in the hollow of sacrum. A. The handle is then raised and at the same time carried across, rotating partly on its axis to B, so that the point D, turning round into hollow of the sacrum to E, strikes the head and rises towards the left side of the pelvis. 2. The second stage or advance of the blade round the head, and up in the left ilium. 3. The third stage; the handle B has travelled in the direction B C, still rotating slightly, until at C it is at rest *in situ*, the shank near the axis where it is held by the back of the operator's left hand, whilst the point of the second blade is passed over and across it inside the perineum, as seen in next figure.

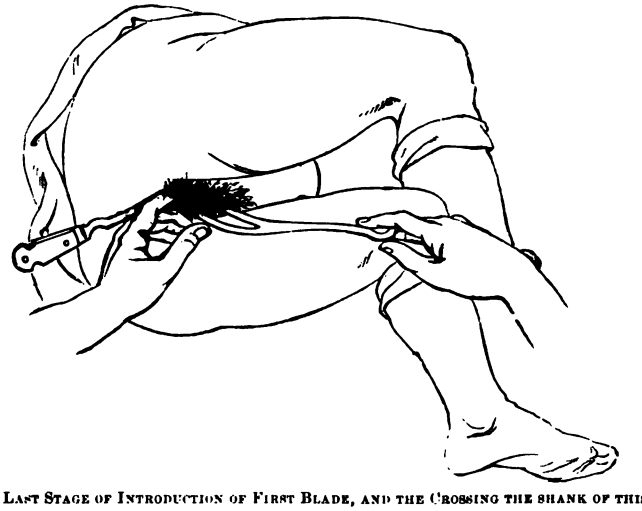
double or compound curve—a segment of a helix—in order to travel round the head-globe, and at the same time to ascend forwards in the direction of Carus's curve to reach the brim of the pelvis, the handle rises, goes backwards, and partly rotates on its axis (see Fig. 194).

3*d Act.*—The handle is now carried backwards and downwards to complete the course of the point around the head-globe and into the left ilium. Slight

pressure upon the handle ought to suffice. This will impart *movement* to the blade; the *right direction* is greatly determined by the relation of the sacrum and head. The blade is now *in situ*. The shank is to be pressed against the coccyx by the back of the operator's left hand whilst he is introducing the second blade. Its weight aids in maintaining it *in situ* (see Fig. 195).

Introduction of Second Blade—1*st Act*.—Two fingers of the left hand, the back of which is supporting the first blade against the perineum, are passed into the vagina and up between the os uteri and the side of the head which lies nearest to the right ilium. The instrument held in the right hand lies nearly parallel with the mother's left thigh, or crossing it with only a slight angle. The point is slipped along the palmar aspect of the fingers in the vagina, across the shank of the first blade *in situ*, and inside the perineum towards the hollow of the sacrum (see Fig. 196).

FIG. 196



SHOWING LAST STAGE OF INTRODUCTION OF FIRST BLADE, AND THE CROSSING THE SHANK OF THIS BLADE BY THE SECOND BLADE IN THE FIRST ACT OF ITS INTRODUCTION. (R. B.)

2*d Act*.—As the point of the blade has to describe a helicine curve to get round the head-globe and forwards in Carus's curve, the handle is now depressed and carried backwards until the blade lies in the right ilium. When it has reached this position the handle will be found near the coccyx, nearly in opposition to the first blade (see Fig. 197).

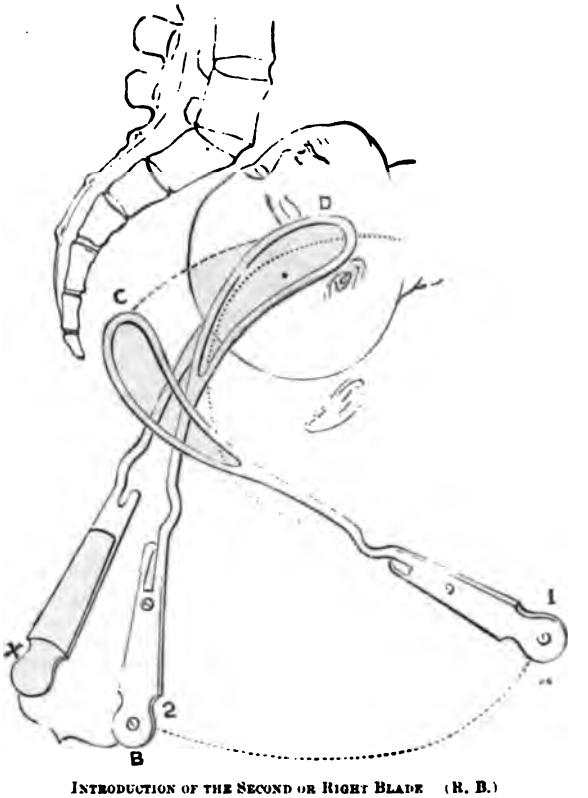
The Locking.—This is effected by slight movement of adaptation. A handle is seized in each hand. The handle of the first blade is brought a little forward over the handle of the second blade. If one blade is a little deeper in the pelvis than the other, it is either brought out or the other is carried in until the lock is adjusted. This is commonly facilitated by pressing both handles back against the coccyx. This movement, by throwing the fenestræ well into the ilia, where there is room, allows the handles to be rotated a little so as to fall into accurate relation (see Fig. 197).

Accurate locking is generally evidence that the blades are properly adjusted, and that the pelvis admits of the successful use of the instrument. On the other hand, their not locking is proof of not being properly introduced, or of the pelvis not admitting of their application. In the first case —that of improper introduction—the failure is generally due to neglect in passing the blades exactly in the same diameter of the pelvis—that is, in

passing the second blade exactly opposite to the first, so that, if the first blade is applied in the left ilium opposite one end of the transverse diameter, the right does not lie at the opposite end of this diameter. To remedy this error, the blade must be partly or wholly withdrawn and readjusted.

In the second case—that of pelvic unfitness—the locking is probably prevented by the projecting promontory or other deformity so distorting the brim that the two blades cannot find room to lie in the same diameter opposite to each other. It will commonly be found that the blades will pass one

FIG. 197.



INTRODUCTION OF THE SECOND OR RIGHT BLADE (R. B.)

1. First stage. 2. Second stage. X. The first blade *in situ*. A. The handle at the moment of passing the point inside the perineum, into the hollow of the sacrum, across X, the first blade; the handle A then drops and goes backwards to B, the point C travelling round the head, and advancing into the right ilium in the direction of the brim to D; when it has reached this position, it will be found nearly opposed to X, the first blade. The locking is effected by bringing the handle X over the handle B.

on each side of the promontory, the inside of the blade not looking towards its fellow but towards the opposite foramen ovale, where a blade cannot be got to lie. When this happens it is best to give up the use of the forceps. Pass the hand into the pelvis if necessary, explore its dimensions and form carefully, and determine between turning and craniotomy.

The Extraction.—Get an assistant to press upon the right hip and support the back. Grasp the handles with one hand, and apply the fingers of the other hand to the ring or shoulders at the lock; draw at first backwards in

the axis of the brim, during the pains if any be present, and at intervals of a minute or so if there be none. Concurrently with traction slight alternate leverage movements may be executed by swaying the handles gently from side to side within a moderate angle not exceeding 20°. Care is taken not to press the shanks against the pelvic walls. Each blade is the fulcrum to its fellow.

Extraction is assisted by pressure *à tergo* upon the fundus uteri.

The advance of the head is measured by the following standards: First, you feel if the occiput approaches the pubic arch by passing a finger below and behind the pubic bones; secondly, sweep the finger round the circumference of the brim, and thus feel if the equator of the head-globe is pressing lower down through the brim; thirdly, by feeling the direction of the sagittal suture: if you find that it is approaching parallelism with the conjugate diameter you may be certain that the head is descending. Further

FIG. 198.

SHOWING DIRECTION OF TRACTION, FIRST STAGE, HEAD AT BRIM. (R. B.)

evidence is found in the rotation of the forceps. As the head can hardly turn upon its cervico-vertical axis without at the same time descending in the pelvis, if the handles of the forceps rotate, this rotation being imparted by the head, is evidence of advance.

Again, as the head descends, of course more and more of the shanks will become visible. This is, indeed, open to a fallacy; allowance must be made for some degree of slipping which takes place with all the English instruments whose blades have only a moderate bow. And, further, when the head is fairly in the pelvic cavity the blades lose in some degree external support.

Fourthly, by two or three fingers you gauge the space or degree of tightness between the vertex and the floor of the pelvis. At first there is free space; gradually the vertex presses on the perineum, bulges it out and puts it tightly on the stretch. The anus is protruded, feces are often squeezed out; indeed, the pressure upon the sphincter ani and vulva at this stage sets up increased reflex action; the call to strain or bear down is uncontrollable.

Turbulent expulsive action, then, and defecation constitute strong signs that the head is advancing. To some extent the increasing caput succedaneum may give a false impression that the cranium itself is descending; but a little attention will correct this error.

At this stage the handles of the forceps may be directed more forwards during traction; the shanks thus avoid stretching the perineum, and the traction is in the axis of the outlet. An assistant is now useful in holding up the right knee, so as to leave room for the operator to carry the handles well round the pubes in Carus's curve. Here it is often convenient to push the handles forward rather than to pull.

The forward direction of the handles must not begin until the occiput is well under the pubic arch. During extraction it occasionally happens that the blades lose their hold, that the blades will twist in opposite directions and thus unlock; this is generally owing to carrying the handles forward too soon. The effect of this is to throw the fenestræ off the head-globe over the face. This is another illustration of the law that the position of the forceps is determined by the relation of the head to the pelvis, and that if we reverse the order by attempting to make the forceps alter their position we are immediately at fault. Axis-traction simple is the law to follow. When the blades slip the remedy is to carry the handles well back, when the lock will be readjusted. During the passage of the head the perineum should be supported by bringing it well forward. By firm pressure from behind and on either side the head is assisted in its exit. Another manœuvre is sometimes serviceable; this is to pass a finger into the rectum, so as to get a point of pressure upon the forehead. In this way it is sometimes possible to bring the face downwards, to start the extension movement, and thus to extricate the head. And if at the same time firm downward pressure be made upon the breech through the fundus, the force propagated through the spine will aid materially in giving the extension movement. This combination of pushing, of leverage, and of "shelling-out" may in certain cases effect delivery without resorting to the forceps. If the head is in the genital fissure, and there is sufficient propelling force, we may proceed to the fourth act, *the removal of the blades*. But generally it is better to keep them on the head as one piece with it until the head is entirely born.

The Time required for Extraction.—If the head be delayed in the pelvis for want of expulsive action, or because it rests upon the ischia, maintaining a too near approach to the transverse diameter, and there is no marked hindrance on the part of either the anterior or posterior valve, it is generally sufficient to use slight traction or oscillation for a few minutes. As soon as the head is started by the forceps the uterus takes up its work, helps the operator, and the labor is quickly over.

If the head has to be seized at the brim from inertia of the uterus, time may often be saved by placing the patient on her back, and supporting the uterus against the spine by the hands of an assistant or a binder. This proceeding, by adjusting the axis of the uterus to that of the brim and getting the aid of gravitation, will greatly facilitate the entry of the head and encourage the action of the uterus. If there is no obstacle in the condition of the passage, gentle traction and oscillation during fifteen minutes will generally complete delivery.

In the event, however, of arrest from pelvic contraction or from want of dilatability of the soft parts, time is a necessary element. The process of moulding can only be effected gradually. Oscillation must be used with great care; what is wanted is steady compression and traction, extended, with moderate intervals of rest, over perhaps an hour or more. Should the head make no advance in entering the brim in that time, and if the handles

of the forceps maintain a marked degree of divergence, and the signs of dystocia rise to indicate exhaustion, the question whether the forceps must not be laid aside for turning or perforation will have to be considered.

THE FORCEPS IN OCCIPITO-POSTERIOR POSITION.—The study of this case is especially interesting on account of the frequency of its occurrence. In the majority of the cases to which we have been called to apply the forceps, the delay was due to this position. The mechanism of labor in this position has been described (see p. 518 *et seq.*). The occiput, taking the promontory as the analogue of the symphysis pubis, is relatively fixed to this point, whilst the head, revolving in Barnes's curve, gets into an unfavorable position in the sacral hollow. The head undergoes extension in the pelvis. Hence the liability to arrest. Release can only be obtained by a movement of flexion.

Flexion may be obtained in two ways: first by conversion into an occipito-anterior position; secondly, by taking the symphysis as the centre of rotation, and the point against which the root of the nose or the forehead is fixed, whilst the vault of the cranium is made to roll over the floor of the pelvis and through the outlet.

The first question that arises, then, is whether we can hope for the change, spontaneously or by art, to an occipito-anterior position. At p. 519 experiments by Dubois are cited, showing that if onward movement be given the tendency to this conversion is great. Smellie effected the change by the forceps. Clarke and Burns said it could be made by the fingers. R. U. West applied his fingers to the frontal bones, turning this part backwards, and at the same time tilting it up until he felt the posterior fontanelle come down. In another case he brought the occiput down by the lever. As soon as the occiput came down, the rotation seems to have been effected by Nature. The essential thing to do is to get the occiput down—that is, to restore flexion. We are persuaded that the head often turns of its own accord when we think we are helping it. Dr. Millar, after assiduously working after the manner recommended by Baudelocque and Dewees, in a considerable number of cases let Nature take her own course, and "found that the desired rotation was generally accomplished about as well without as with his assistance." Leishman says, "We may succeed in amending the position in two classes of cases. In the first, the head is free at the brim, and here rotation may be effected by the forceps. In the second, the head has reached the floor of the pelvis, where we have natural rotatory forces operating in our aid. No attempt, while the head is in a position intermediate between these two, is likely to be attended with success. In the second class of cases the forceps is quite inapplicable (for the purpose of rectification). We must employ our whole efforts in promoting the preliminary flexion. This is done most effectively by bringing two fingers to bear upon it, and pressing in the direction indicated during a pain."

We have found that the occiput must be brought down below the edge of the sacro-sciatic ligament to permit of the rotation face backwards. But we cannot give more than a qualified assent to the attempts to rectify the position. It is only exceptionally useful; still more rarely is it necessary; and it is not free from danger. In Leishman's first case, the head free at the brim, it is quite premature to interfere. The rotation is most likely to take place spontaneously if let alone. In the second case, his manœuvre postulates a driving force. This is often wanting. The pains are apt to flag when the head is on the floor of the pelvis.

The fact is that the head can be born very well, preserving the occipito-posterior position throughout. We think this occurs more frequently than Naegelé represents. Nor does the case call for force. By help of the forceps

the delivery is nearly as easy as in occipito-anterior positions. In the event of delay, then, we advise resort to the forceps.

In traction there are two things to be observed: the perineum is put more upon the stretch, and therefore requires more care; if the handles of the forceps are carried forwards towards the mother's abdomen too soon, the bows will be apt to slip off. The perineum is severely tried, and laceration is sometimes unavoidable.

The blades should be introduced as described in the case of occipito-anterior positions. They will be guided by the head into the most suitable position. *Extraction simply*, without troubling ourselves about rotation, is all that is necessary. If Nature prefer to insist upon rotation, our business is to assist. As the head advances, the occiput may come forwards. But in a large proportion of cases Nature will not insist upon bringing the occiput forwards; and here, again, our part is simply that of a minister of Nature. The forehead will emerge under the pubes; the cranium will sweep the sacrum and perineum.

As the blades of the forceps preserve their original relation, the handles will turn with the head. It is labor lost, it is encumbering Nature with superfluous help, to attempt to promote this turn by twisting with the forceps.

THE FORCEPS IN BROW AND FACE PRESENTATIONS.—The mechanism by which these presentations are produced has been described (p. 521). The study of this process indicates the principle upon which rectification must depend. The face descends because the occiput, encountering excess of friction against the pelvic brim or in the lower segment of the uterus from obliquity, the head rotates on its biparietal diameter. We have seen that, if excess of friction can be transferred to the forehead or anterior pole of the head-lever, the occiput may descend, and the vertex be substituted for the face. We also showed the process by which Nature extricates herself from the difficulty when the head and part of the thorax get jammed in the pelvis. Sometimes, however, the head in face-presentations is neither rectified by art nor by Nature. It is arrested in the pelvis.

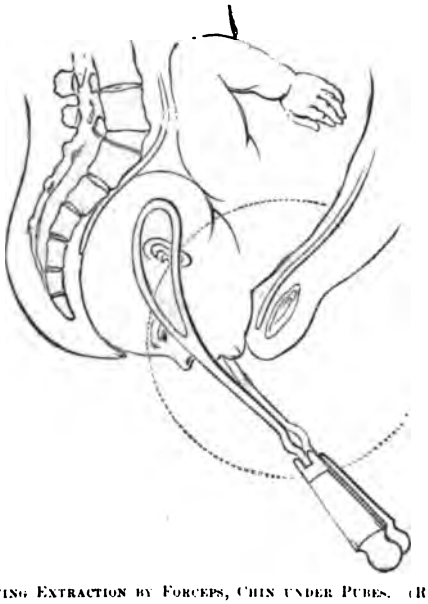
Let us first take the case of arrest in the stage of face-presentation when the chin has effected its rotation forwards, coming under the pubic arch. In Figs. 140 and 141, we see this condition. The head is in strong extension; occiput jammed between the shoulders. This extension was produced by the relative fixing of the occiput on the pelvic brim, whilst the face and chin travelled in Barnes's curve. Now the object desired is to restore flexion, so as to decompose the wedge formed by the head and thorax. This is to be done by making the head rotate on its transverse axis, bringing the occiput down and making it travel through the pelvis in Carus's curve. The problem, in short, is how to reverse the movement by which the face presentation was produced.

The blades of the forceps should be applied so as to seize the head nearly in its transverse diameter. Now, the face presents some degree of obliquity in relation to the pelvis. The first or sacral blade, therefore, must pass up the left side of the pelvis, somewhere between the sacro-iliac joint and the left extremity of the transverse diameter. The second or pubic blade will pass in the opposite point of the pelvis—that is, between the foramen ovale and the right extremity of the transverse diameter. When locked, traction is at first directed downwards to get the chin fairly under the pubic arch. Then the traction is directed gradually more and more forwards and upwards, so as to bring the vault of the cranium out of the pelvis. The posterior part of the head puts the perineum greatly on the stretch. The final stage of extraction requires great care. Give time for the perineum to dilate. Carry the handles well forward so as to keep the shanks out of the way.

But some cases will not proceed so smoothly. Some of the most difficult cases to which we have been summoned have been face presentations. Sometimes the *face will not enter the brim.* What is to be done? If we apply the forceps one blade is likely to seize beyond the jaw and compress the neck, bruising the trachea. If the attempt be made to seize the head by applying the blades in the oblique diameter, the fenestræ must be passed very high, and even then may slip; if firmly grasped and traction be made, the faulty extension of the head is increased, the compression of the vessels of the neck and the danger of apoplexy are augmented, and after all extraction may have to be completed after perforation. Turning can be effected with infinitely less trouble, and with a better prospect for the child.

In another class of cases, *the face has descended into the pelvis.* The birth of a full-grown living or recently dead child, the forehead maintaining its direction forwards, is almost impossible. The extension of the neck is

FIG. 199.



SHOWING EXTRACTION BY FORCEPS, CHIN UNDER PUBES. (R. B.)

extreme, the head being doubled back upon the nucha. The chin represents the apex of a wedge, A B C (see Fig. 142), the base of which is formed by the forehead, the entire length of the head, and the thickness of the head and chest. This must be equal to at least seven inches. The bregma and occiput become flattened in, but not much is to be expected from moulding. The case is that the natural mode of decomposing the wedge by the rotation of the chin forwards will not take place. Hence arrest or impaction. The child is in imminent danger. Aid becomes necessary. We have to consider the following points:

1. Can the head be rotated on its transverse axis, restoring flexion in the pelvis? This is scarcely possible when the head is jammed in the pelvis.

2. Can the turn of the chin forward be effected by the hand, lever, or forceps? This is sometimes possible, and should be tried. The method is thus described by Smellie: "After applying the forceps along the ears, push

the head as high up in the pelvis as is possible, after which the chin is to be turned from the os sacrum to either ischium, and afterwards brought down to the inferior part of the last-mentioned bone. This done, the operator must pull the forceps with one hand, whilst two fingers of the other are fixed on the lower part of the chin or under jaw, to keep the face in the middle and prevent the chin from being detained at the os ischium as it comes along, and in this manner move the chin round with the forceps and the above fingers brought under the pubes, which done the head will easily be extracted."

3. Can the head be brought down by the forceps without turning the chin forwards, trying to extract in Carus's curve? This is a practice against Nature. The forceps will be likely to slip, and if it hold it will bring more

FIG. 200.

BROW PRESENTATION. (R. B.)

of the wedge into the brim. The head must be small or the pelvis large to admit of success.

4. Shall we extricate the head by perforating it? In extreme cases this course may be necessary. It is not easy, unless the bones be broken away, or crushed in by the cephalotribe.

5. The chin will sometimes turn forwards at the very last moment, when the face is quite on the floor of the pelvis. If not, it may be possible to hitch the chin over the perineum by drawing the chin forwards by the forceps and pulling the perineum backwards (see Fig. 142). The chin thus outside, the forceps may be applied to draw the occiput down under the pubes and backwards, so as to make the head revolve on its transverse axis around the coccyx as a centre in the coccygeal or Aveling's curve. The delivery is thus effected by a process the reverse of that of ordinary occipito-anterior

labor, and in a different orbit. In the mento-sacral position the delivery takes place by promoting flexion. Bilateral incision of the perineum may be desirable to facilitate the release of the chin.

Dystocia from Pendulous or Overhanging Belly—the "*uterus en besace.*" Since a main factor in the production of this condition is an extremely lax state of the abdominal walls, it is most frequent in women who have borne many children. In some cases there is separation of the recti abdominis muscles along the linea alba; then there may be hernia of the gravid uterus. Another favoring condition is contraction of the pelvis with lordosis. The projecting lumbar curve throws the uterus forwards. When this condition exists, the uterus,, hanging down like a pack-saddle over the pubes, is widely out of the axis of the pelvis; and if there is pelvic contraction, the child would be directed over the brim, against the promontory (see Fig. 201).

This fault may sometimes be remedied by placing the woman on her back, and supporting the abdominal walls by applying a broad binder, so as to lift up the fundus of the uterus. This will restore the relation between the axis of the uterus and that of the pelvic brim. But if contractile energy be still wanting, the forceps will come into requisition. This is a case where the dorsal decubitus is especially desirable.

The alternative of the forceps in these cases is likely to be turning. How shall we determine the choice? There are two principal cases: First, the liquor amnii has drained off and the head is pressing into the brim. The forceps is strongly indicated here. Secondly, the head is mobile above the brim, and not easy to grasp in the forceps. If by pressure we cannot push the head into the brim, turning will be preferable. We have several times rescued a living child by turning under these circumstances. The second case may sometimes be reduced to the first, and thus brought within the more desirable dominion of the forceps. One result of the pendulous belly and uterus is to form a kind of reservoir in which the liquor amnii is dammed up; hence an added impediment to contraction of the uterus. The waters can be drained off by lifting the fundus uteri up to its normal position, and making a channel past the head to the uterine reservoir by introducing one blade of the forceps. Having accomplished this, under steady pressure by the hands or a broad belt, the uterus may recover its form and expel the child. If not, the forceps comes into play.

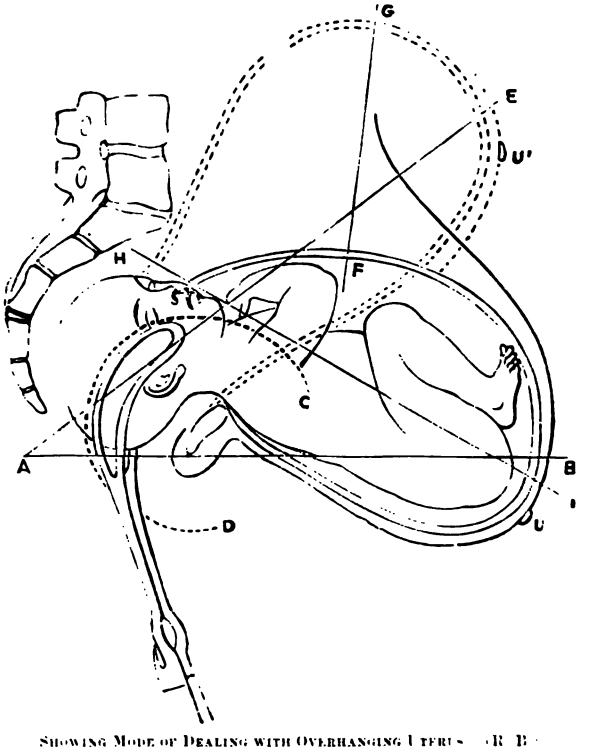
Until the uterus is brought to its normal position, two causes concur to render labor difficult. First, the uterus being thrown forwards, its fundus is carried away from the diaphragm and upper part of the abdominal walls. It loses, therefore, the aid which the expiratory muscles, acting powerfully when the glottis is closed and the chest is fixed, usually give. When the uterus is thrown forwards across the pubes, any force propagated downwards from the diaphragm will strike the posterior wall of the uterus at a right angle with the body of the uterus and the long axis of the fœtus. It will, in short, drive the uterus and its contents down upon the symphysis, or even more forwards still, since the body of the child, which lies in front of the symphysis, forms the longer arm of a lever, and the force is expended upon it (see Fig. 203).

Secondly, the uterus, if not paralyzed, acts in a wrong direction. It is a law, of which the patient observer will not fail to discover many proofs in the progress of difficult labor, that whensoever a mechanical obstacle is encountered, before long, the uterus, conscious, as it were, of the futility of its efforts, intermits its action, takes a rest until the time shall arrive when it can act with advantage. This provision protects for a long time against

exhaustion from protracted labor and the danger of bursting. Indeed, what appears to be protracted labor is often simply "suspended labor."

In Fig. 201, the uterus and child are represented lying across the symphysis pubis; H I is the line in which the proper uterine force would be exerted; F G is the line of force of the expiratory muscles, striking the long axis of the uterus behind and nearly at a right angle. These two forces, which ought to coincide, thus cross each other, and the error is but imperfectly compensated by the resultant force obtained between the two. But raise the uterus to its normal position, as indicated by the dotted outline, and immediately the expiratory force and the uterine force coincide with the axis

FIG. 201.



SHOWING MODE OF DEALING WITH OVERHANGING UTERUS. (R. B.)

A B. Datum-line. C D. Carus's curve. A E. Axis of pelvic brim. F G. Line of expiratory force. H I. Line of uterine force.

of the child and of the pelvic brim, and both conspire to expel the contents of the uterus.

In the case of pendulous belly from contracted pelvic brim, the restoration of the axis of the uterus to its proper relation with that of the pelvis can rarely be effected until the head is brought into the pelvic cavity; and this has to be done after craniotomy. Then the dorsal decubitis and upward support of the abdomen and uterus come in effectively.

THE FORCEPS TO DELIVER THE AFTER-COMING HEAD.—In breech and turning cases, it is a matter of great moment to deliver before the cord has undergone long compression. In the majority of cases, provided the passage of the breech, trunk, and shoulders have not been hurried, the cervix will

have been dilated enough to allow the head to follow without dangerous delay; but if, in consequence of precipitate aid, the arms run up by the sides of the head, or other obstacles occur, the head may be caught in the brim and the child may be lost. Besides compression of the cord, the child has to run another not less serious danger—this is dislocation of the neck, if traction be unskilfully or hastily performed. It is practically very difficult in some cases to draw the head by the shoulders in due axial direction. The slightest deviation from this direction involves hitching against the pelvic brim; and under continued traction the intervertebral ligaments are apt to give way.

Both these dangers are best averted by putting on the forceps. Traction then bearing upon the head, all drag upon the spinal column is spared.

How to apply the forceps: In the first place a loop of cord should be gently drawn down, so as to take off any dragging upon the umbilicus, and place the part which traverses the brim in that side in which the face is found. The head is engaged with its long axis more or less nearly in the transverse diameter of the brim. The blades should seize it in an oblique

FIG. 202.

SHOWING FORCEPS APPLIED TO AFTER-COMING HEAD. (R. B.)

diameter approaching the conjugate. To effect this, the child's trunk should be carried well forwards over the symphysis, and held there by an assistant, so as to leave the outlet clear for manipulation. Then, passing the left hand into the vagina, carry the fingers to the left side of the pelvis between the cervix uteri and the head. The blade is slipped up along the palmar aspect of the fingers to its place. The like proceeding is then repeated on the right side of the pelvis, and the blades are locked. The assistant still (see Fig. 202) supporting the child's body, the operator draws the head into the pelvis in the axis of the brim. As soon as this is cleared, the forceps may be removed and extraction finished by the hands. This is done by hooking two fingers of the right hand over the back of the neck on the shoulders, whilst the left hand seizes the feet above the ankles, a napkin interposed. Then extraction is made in the axis of the pelvic cavity and outlet. It is the work

of a few seconds. Some will prefer completing the extraction with the forceps. If this mode be adopted, the face will be turned towards the sacral hollow when the head has cleared the brim; the forceps, following the sacral curve, rotates a little during traction. When the occiput is appearing under the pubic arch, the handles are carried well forwards, so as to bring the face over the perineum with the least possible strain. The face and forehead sweep the perineum, describing a curve round the occiput resting upon the pubes.

The use of the forceps to the after-coming head was strongly inculcated by Busch, who attributes to this practice the extraordinary success of turning in his hands. Of forty-four cases of turning, only three children are said to have been lost from the effects of the operation. E. Rigby and Meigs also insisted upon the advantage of the practice. Our own experience enforces the precepts of these eminent authorities. If the practice have not been better appreciated in this country, it is because it is only within the last thirty years or less that a forceps adequate to the work has been generally known.

Dangers to Mother and Child from use of Forceps.

1. THE LOW OPERATION—head in pelvis, no disproportion or malposition, performed in time with proper skill—is absolutely harmless to mother and child.

2. THE MEDIUM OPERATION—head high in pelvis—is attended by some risk to mother from protraction: from bruising or crushing soft parts of mother. Thus the obturator nerve or the sacral plexus may be compressed, and temporary paralysis of the parts supplied by them may result.

The child's head has to undergo more compression; a blade may bruise the portio dura, and paralysis, temporary, of the eyelids and mouth result.

3. IN THE HIGH OPERATION—head on brim—the dangers arise. To the mother there is more risk of laceration of cervix uteri, of bruising the vagina. But if skilfully performed, and in time, the operation itself can hardly be said to involve mortality. To the child the risk to life from compression is serious; but this risk is to be set against the probably greater risk of turning, and the certain destruction of craniotomy. The cranial bones are sometimes depressed, even bent, blood effusions caused in the scalp and between the dura mater and cranium, or the brain itself injured. There is greater likelihood of injury to the portio dura. Sometimes the eyeball is injured.

All these injuries are more probable when there is slight projection of the promontory. The depression of the skull may be due to this.

George Kidd, Johnston, and Atthill generally agree in the conclusion that in proportion as the forceps was freely used in cases of tedious and difficult labor, the deaths of the mothers decreased, and the lives of the children were saved. Under Atthill the use of ergot was absolutely prohibited in the Rotunda Hospital.

Note on the Value of Statistics as Applied to Obstetric Operations.

Gross indiscriminate statistics, seeming to show that forceps and other operations have caused a certain mortality, are fallacious. The issues of operations under different circumstances must be discriminated. Rigorous analysis on clinical lines must precede the construction of tables. Accidents which ought to be set down to delay, neglect, and unskilfulnes, have been set down to operations which are essentially conservative.

CHAPTER XXVII.

Version or Turning.

SPONTANEOUS; ARTIFICIAL; CEPHALIC; BIPOLAR; DESCENT OF HAND BY SIDE OF HEAD; PROLAPSE OF UMBILICAL CORD; ENTANGLEMENT OF CORD; DIFFICULT BREECH-LABORS; DIFFICULT TWIN-LABORS; NUCHAL DISPLACEMENT OF AN ARM; EXCESSIVE SIZE OF CHILD'S ABDOMEN; DYSTOCIA FROM MONSTERS; HERNIA; PODALIC BIPOLAR TURNING, LIQUOR AMNII PRESENT, AND WHEN RUN OFF; IMPACTION; IMITATION OF SPONTANEOUS EVOLUTION; EVISCERATION; BISECTION; DECAPITATION; SPONDYLOTOMY; TURNING IN NARROW PELVIS; DANGERS TO MOTHER AND CHILD FROM TURNING.

TURNING ranks next to the forceps as a conservative operation. It competes with the forceps on the conservative side, and with craniotomy against sacrificial obstetrics. Before the forceps came into use, there is no doubt that turning was much more frequently resorted to; and it may be added that with the improvements in the forceps the motive for resorting to it diminishes.

In this chapter certain cases of dystocia, not necessarily involving turning, are described.

DEFINITION.—Version comprehends all those proceedings by which the long axis of the child is brought into coincidence with the axis of the pelvis.

In familiar language we call the operation *turning;* the synonyms are: versio, version, Wendung.

Version may be: (1) Spontaneous; (2) Artificial.

1. Spontaneous version has been described in the chapter on the "Mechanism of Labor."

In spontaneous version, Nature points out the object to be attained, and how to attain it—that is, by *artificial version.* A spontaneous version may be effected either by bringing the head first into the pelvic brim or the breech; so one of the like changes of position is sought to be accomplished by artificial version.

2. *Artificial cephalic version.* The conditions favoring this operation are: (*a*) The latter end of gestation; (*b*) the presence of liquor amnii; (*c*) moderate obliquity of the uterus and child's axis in relation to the axis of the pelvis; (*d*) the head being near the pelvic brim.

THE OPERATION.—A successful imitation of natural version demands the concerted use of both hands. We must act simultaneously on both poles of the fœtal ovoid. This action may be carried out altogether externally—that is, through the walls of the abdomen; or one hand may work externally whilst the other works internally through the os uteri. The first method—that practised by Wigand, Esterlé, and others—has been called the bimanual proper; the second, which was first clearly taught by Braxton Hicks, was called by him "combined internal and external version." Both are forms of *bipolar version.* This term, proposed by Robert Barnes in the first edition of the "Obstetric Operations," has since been generally adopted. Each form has its own field of application. But the combined internal and external bipolar method has the more extensive applications in practice.

The history of bipolar version demands a few lines. It seems clear that Wigand, D'Outrepont, and others who took up Wigand's views, had acquired an accurate perception of the theory of bipolar turning, and had successfully applied it in practice. They had applied it to the purpose of altering the position of the child before labor, chiefly by bringing the head over the centre of the pelvis, restoring at the same time the uterus and fœtus from an oblique to a right inclination. This they did chiefly by external manipulation, but not exclusively, for sometimes one or two fingers introduced into the os uteri served to drag the lower segment of the uterus to a central position, whilst the hand outside acted in the opposite direction upon the upper pole. There the application seems to have stopped short. At least, we are not aware of any distinct description of the application of the bipolar principle to produce complete version.

In one form the bipolar principle of turning by the feet has been in use for a long time. In oblique presentations, when turning is attempted after the waters have escaped and the uterus has contracted upon the child, it may be found that although one or both feet have been seized the head will not recede or rise. It then becomes obvious that by some means the head must be pushed up. This is commonly effected by holding down the leg or legs whilst a hand or crutch passed into the pelvis pushes up the head and chest. In this operation both hands work below the pubes.

In several works—those of Moreau, Caseaux, Churchill, and others—diagrams are given representing one hand applied to the fundus uteri outside and the other seizing the feet inside; but it would be an error to suppose that these indicate an appreciation of the principle of bipolar turning. They simply indicate the principle of *supporting the uterus*, so as to prevent laceration of the cervix whilst pushing the head into the uterus. The true bipolar method does not involve passing the hand into the uterus at all.

Sir James Simpson (1845) got nearer the mark: "Use both your hands for the operation of turning. . . . Whilst we have one hand *internally* in the uterus, we derive the greatest possible aid in most cases from manipulating the uterus and infant with the other hand, placed externally on the abdomen. Each hand assists the other to a degree which it would not be easy to appreciate except you yourselves were actually performing the operation. . . . The external hand fixes the uterus and fœtus during the introduction of the internal one; it holds the fœtus *in situ* whilst we attempt to seize the necessary limbs, or it *assists in moving those parts where required towards the introduced hand;* and it often aids us vastly in promoting the version after we have seized the part which we search for. Indeed, this power of assisting one hand with the other in different steps of the operation forms the principal reason for introducing the left as the operating hand."

Here the principle of bipolar turning is at best but dimly foreshadowed.

Robert Lee practised a manœuvre of *tipping* the presenting shoulder or breech away from the os uteri by one or two fingers passed through the os only. This was mostly done in cases of placenta prævia, the fœtus being premature and small. It is not shown that he used an external hand. By a process of synthetical reasoning Robert Barnes had arrived at the true principle. In the "Obstetric Operations," 1876, he says that in more than two hundred cases of turning he had never failed to follow Simpson's precept to use both hands, and he gradually found out that the external hand often did more than the internal one, so much so that the introduction of one or two fingers through the os uteri, to seize the knee pressed down upon the os by the outside hand, was all that was necessary.

Still, Braxton Hicks's claim to originality in working out and expounding the application of the external and internal bipolar method of podalic version

is indisputable. His work on this subject is contained in a memoir in the "Lancet," 1860, in the "Obstetrical Transactions," 1863, and in a special work in 1864.

Artificial Cephalic Version.—As head presentation is the type of natural labor, it follows that to obtain a head presentation is the great end to be contemplated by art. But, practically, head-turning is little known. Delivery by the feet is almost universally practised when the substitution of a favorable for an unfavorable presentation has to be accomplished. Why is this? The answer is not altogether satisfactory; it rests chiefly upon the undoubted fact that, in the great majority of instances, at the time when the malpresentation comes before us, turning by the feet is the only mode of turning which is practicable. Frequent experience of one order of events is apt so to fill some minds as to exclude the recognition of events that are observed but rarely. They conclude that the course which is proper for most cases is proper for all; and, adopting this course in all cases, they shut out the possibility of learning what Nature can do or what can be achieved by other means.

In the seventeenth century and in the beginning of the nineteenth, Velpeau remarks that cephalic turning was hardly ever mentioned unless to be condemned. Flamant was amongst the first to revive the practice. In two cases of arm presentation he raised the breech towards the fundus uteri; the head, thus made to descend, was seized by the hand. The liquor amnii had long escaped. He worked on these cases entirely by *internal* manipulation. Wigand accomplished the same object by *external* manipulation, saving the children. E. Martin, Hohl,[1] Lazzati, and others advocate the practice.

The Indications for Head-turning.—A. Before the accession of labor: When the uterus and fœtus are placed obliquely in relation to the pelvic brim; and in some cases where the shoulder is actually presenting. B. When labor has begun: 1. When the uterus and fœtus are placed obliquely in relation to the pelvic brim, which obliquity may be preparatory to the complete substitution of the shoulder for the head. 2. In some cases of shoulder presentation, the membranes being still intact. 3. In some cases of shoulder presentation, the membranes having burst, but considerable mobility of the head being still preserved. 4. The forehead or face presenting. 5. Descent of the hand by the side of the head. 6. Prolapse of the umbilical cord by the side of the head.

A. *Head-turning or Rectification before Labor.*—Esterlé, the great advocate for this operation, was lead to adopt it from the observation of the frequent occurrence of spontaneous version. He had remarked that this change had occurred after the escape of the liquor amnii and the shoulder was down. The patient must be placed in such a posture as to produce the greatest possible muscular relaxation. Bearing in mind the conditions which take part in spontaneous version, it is necessary to imitate them as much as possible. Amongst these is the lateral contraction of the uterus, which diminishes the transverse diameter, and which exerts a convenient pressure upon the ovoid extremities of the child; and the movements of the fœtus, the repercussion of its head, and its descent, when the centre of gravity of the fœtal body favors its fall. To imitate this, the lateral contractions must be replaced by lateral pressure. This is applied towards the fundus or the cervix, according to the situation of the part which it is sought to raise or to depress. This pressure is assisted greatly by gentle strokes or succussions by the palm of the hand alternately towards either ovoid extremity. These strokes are then made in rapid succession simultaneously upon the two

[1] Lehrbuch der Geburtshülfe, 1862.

extremities, one giving a movement of ascent, the other a movement of descent; or we may act upon the head alone, whilst the other hand makes a steady pressure on the contrary side, the more to diminish the transverse diameter. The desired position being effected, it is necessary to maintain it. This is done by the adaptation of cushions or pads to the sides of the opposite poles of the fœtal ovoid, and supporting them by a bandage.

B. 1, 2, 3. Head-turning may be tried in cases of moderate obliquity, the liquor amnii being still present, or only recently escaped. It is also important that the action of the uterus be moderate. Supposing the case to be one in which the head is deviated to the left ilium, and the fundus, with the breech, is directed to the right of the mother's spine, the first step is to place the woman on her left side. In this posture, the fundus of the uterus, loaded with the breech, and being movable, will tend to fall towards the depending side. This will act as a lever upon the uterine ovoid, and the lower end of the uterus with the head in it, so as to facilitate its return to the brim. In such cases, Wigand recommends that the posture should be repeatedly changed, so as to ascertain which is the best to maintain the head in the central line of the pelvis. When this is found, the sooner the membranes are ruptured the better. The patient must henceforth be kept carefully in the same posture, the uterus being supported in due relation by the hands externally. But we believe that in many cases the dorsal posture will lend the greatest facility.

We must apply pressure to the uterus towards the median line of the mother, both at its fundus and at the lower part, which contains the head. The head will thus be pushed by one hand to the right, whilst the fundus uteri is pushed by the other hand to the left.

If labor have begun, we may combine internal with external manipulation. We may press upon the fundus with one hand, whilst with a finger in the os uteri we pull this over the centre of the brim. External pressure by a pad laid in the hollow of the ilium in which the head lay will aid the manœuvre. Then, having got the head into the proper position, whilst it is kept so by an assistant, rupture the membranes. The contraction of the uterus tends to restore its natural ovoid shape, and will also tend to keep the child's long axis in due relation. If by this contraction the head should happily become fixed in the brim, the manœuvre has succeeded; the labor has become natural. But if the head still show a disposition to recede, it should be grasped at once by the forceps, and held in the brim until it is sufficiently engaged to be safe.

4. The mode in which *forehead and face presentations* arise out of excess of friction or resistance encountered by the occiput, and the way of restoring the vertex to its right position, have been described.

5. *Descent of the Hand by the Side of the Head.*—When this accident occurs it is apt to proceed to shoulder presentation, the hand and arm slipping down and wedging the head off the brim to one or other iliac fossa. Hence the importance of correcting this complication as early as possible. Whilst the parts are still movable it is commonly possible to push up the presenting hand by means of one's left fingers in the vagina; and at the same time, by pressing down the head by the external hand towards the brim, the head is made to fill the space until the forceps is applied. Then, drawing the head into the brim, the hand cannot again descend.

6. *Prolapse of the umbilical cord by the side of the head* may sometimes be managed successfully in a similar manner to that described above for the hand, having first replaced the cord above the head. But there are other forms of *prolapse of the cord* which call for more detailed description.

The *causes* which lead to prolapse of the cord are generally those which

favor the production of malposition of the child, such as pelvic distortion, placenta prævia, excess of liquor amnii. All causes that hinder the complete filling of the lower segment of the uterus and the pelvic brim by the presenting part of the child, of course, leave room for a loop of cord to fall through. The cord is especially apt to be hooked down if it be overlong, if it take its origin near the orificial zone of the uterus from the lower margin of the placenta; and if there be a sudden rush of liquor amnii when the membranes burst the cord is apt to be swept down with the stream.

One thing deserves attention. Prolapse of the cord has frequently happened when the patient has been sitting or standing up at the time the membranes have burst. Hence it is desirable to keep the patient on her bed when this event is expected; and then, should the funis come down, the accident may be detected at the earliest moment—a point of paramount importance. The pressing indication is to rescue the child from the danger of perishing by asphyxia.

There are *two periods of prolapse*. The management varies accordingly. The first case is when the cord is felt below the presenting part of the child whilst the membranes are still entire. Hitherto the risk of pressure upon the cord is small. It is rarely necessary to interfere before the membranes burst. But when the cord is felt through the membranes we must be prepared for the coming event, and also for the probability of some other part of the child than the head presenting. The moment the membranes burst, the cord will probably be carried down by the torrent of liquor amnii. If the cervix uteri be freely open at the moment of bursting, the condition will be so far favorable for immediate efforts to replace the cord or to deliver promptly; but should the cervix be only moderately open the risk is greater. In this case we should do well to dilate the cervix before the membranes burst by the water-bags, so as to insure freedom for manipulation. We must be ready to act according to the indications of danger to the child and the presentation.

Since, during the passage of the child, the prolapsed cord must undergo protracted compression, the child's life is in imminent danger. Rescue will depend upon one of two conditions: first, upon reposition of the funis above the presenting part of the child, and its retention there; or, secondly, upon the speedy delivery of the child before fatal asphyxia has occurred. Sometimes we have a choice in the method of proceeding; sometimes the course of action is imperatively dictated by circumstances. For example, if there is a shoulder presentation, there is obviously a major reason for turning. If there is placenta prævia, with profuse hemorrhage, to secure the safety of the mother must be the first object. For this, turning may be indicated; indeed, that which is best for the mother often gives the chance for the child also. In the case where the cord springs from the margin of the placenta, and this margin descends to near the orifice of the womb, it is clear that there is not much hope of keeping up the cord, even if we succeed in putting it back into the uterine cavity; the next pain will expel it again. The prospect of saving the child depends upon prompt delivery. If the head present, it is best to put on the forceps at once; if the os is not sufficiently dilated, apply the water-bags; or, if it appear that delivery can be effected more quickly by turning, adopt this operation.

If there be contraction of the conjugate diameter of the pelvis, so that the cord slips down on one side of the promontory where the brim cannot be blocked by the head, we may try to replace the cord before proceeding to deliver. The same thing should be tried when there is no deformity, and when the cord springs from the higher zones of the uterus.

As to the Modes of Reposition of the Cord.—We may occasionally—rarely, it is true—take the prolapsed loop in the fingers of the left hand, and, in the absence of contraction, carry it up into the uterus above the presenting head, and even hang it over the child's knee or foot. Unless we succeed in thus finding a peg for it, it will almost certainly follow the hand down again as we withdraw it. And whenever we have succeeded in carrying the cord into the uterus, we must immediately try to fill up the pelvic brim with the child's head. This may be done sometimes by external pressure with the hands, or better still by the forceps. When the cord comes down in breech or feet presentation, we may do as Wigand did—carry up the cord with the hand, and immediately bring down a leg into the os uteri.

Another mode of replacing the funis is by help of the so-called *knee-elbow posture*. Thus, the pelvis is raised above the level of the fundus of the

FIG. 203.

SHOWING REPOSITION OF PROLAPSED CORD IN KNEE-ELBOW POSTURE. (R. B.)

Roberton's tube carries the cord above the head to A. The stilet is then withdrawn, and the tube left in situ.

uterus, and not only gravitation, but a suction force of the abdominal cavity is brought into aid. But, even here, the forceps must be used to bring the head into the pelvis. This plan was taught by the late Dr. Bloxam, when Robert Barnes was house-surgeon under him at Queen Adelaide's Lying-in Hospital, forty years ago. It has since been enforced and successfully applied by Thomas, of New York, under the name of the Postural method (1858), by Theopold (1860), by Wilson, of Glasgow (1867), and others.

We may, by help of this posture, succeed by the hand alone. But a special instrument to replace cord may be useful, a multitude of instruments have been invented. None surpass in simplicity and effectiveness the contrivance of Roberton. This is a long flexible rubber catheter of large calibre mounted on a stilet, with a large eyelet-hole near the blind end.

Fig. 201 represents the tube in action. A loop of coarse soft silk or worsted is carried through the tube and out at the eyelet, or a loop of worsted may be tied upon the end of the catheter. The prolapsed cord is caught in the loop. The tube is then carried by the stilet past the presenting part of the child until the cord is fairly lodged in the uterus. Then, applying a finger of one hand to the lower end of the tube, the stilet is withdrawn, leaving the tube and cord *in situ*. The tube will come away with the placenta when the child is born.

If the cord is flaccid and pulseless, especially if the prolapsed loop is cold, and if tickling the child's feet excites no reflex movement, it *may be presumed* that the child is dead. But it is proper to auscultate the abdomen; and, if the hand is passed into the uterus, we should take the opportunity of feeling the child's chest for the heart-beat. If the child is known to be dead, the indication is clear to turn our attention exclusively to the interest of the mother.

Allied to prolapsus is the *entanglement of the cord round the child's neck.* The cord being perhaps of excessive length, and the child's head being prevented from filling the lower segment of the uterus, a loop of cord lodges there, so that when the cervix opens the head passes through the loop. This is the most common mode of production. But it may occur before labor under spontaneous version. The child commits suicide by hanging. Occasionally two, or even three, coils are found round the neck. The effect of this accident is that, as the child descends through the pelvis, the cord tightens round the neck, tending to strangle it. The labor is likely to be arrested from the child being held back by the cord dragging upon the uterus.

It is a good rule in ordinary labor, the moment the head is born, to pass the finger round the neck to feel if the cord encircles it. If it is found loose and the body is advancing, so that you have no time to bring the loop over the head, open the loop and let the child's body pass through it. But if the head is not advancing, if it be observed that after every pain the head seems to be retracted, if there is unusual uterine pain, and especially if the child's face is becoming congested and the cord is felt tight and pulseless, not a moment should be lost in passing a finger under the cord and severing it. Then accelerate the birth of the child, and tie the cord at the usual distance from the navel. If it be feared that the child may bleed, both ends of the divided cord may be tied before delivery. But this is not really necessary.

The Management of Certain Difficult Breech Labors.

The management of ordinary breech labor has been already described. Usually it proceeds smoothly enough under spontaneous forces. But there arise cases in which aid is necessary. The true rule in giving aid is to produce a position more favorable to delivery; and thus the manœuvres called for fall under our definition of version. Since the breech is already presenting, a great part of the end contemplated in podalic turning is already accomplished. The problem is, so far, simpler than that of effecting complete version; and it may, therefore, logically and usefully serve as an introduction to the description of version for shoulder presentation.

There are two principal conditions of breech presentation under which labor may become arrested or difficult. Whether the position be dorso-anterior or dorso-posterior, the legs may be disposed in one of two ways: First—and it is the most common way—the legs may be flexed upon the thighs, so that the heels are near the nates, and—what is very important to recollect

—not far from the os uteri (see Figs. 143, 144, 204); or, secondly, the legs may be extended so that the toes are pointed close to the face (see Fig. 206).

In both cases the breech represents the apex of a wedge entering the

FIG. 204.

SHOWING HOW TO SEIZE A FOOT, TO BRING IT DOWN WHEN BREECH IS DELAYED IN THE PELVIS. THE LEGS ARE FLEXED IN NORMAL ATTITUDE. (R. B.)

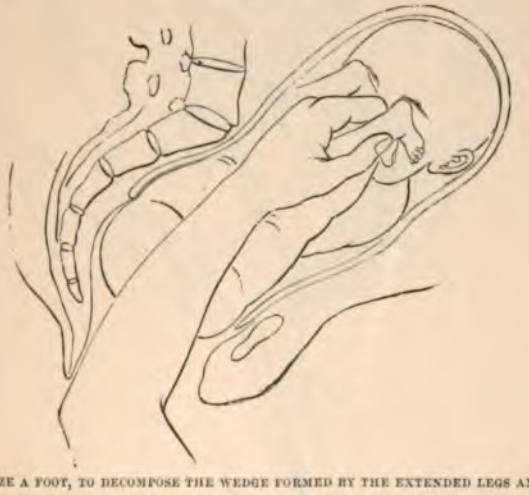
FIG. 205.

DELIVERY OF BREECH BY DRAWING DOWN ONE F

pelvis, whilst the base is delayed at the brim. The indication is to decompose the wedge. The principle of action is the same. To take the simpler case first, that in which the legs are flexed upon the thighs, the feet near the nates. In this case (see Fig. 204) the manœuvre is simple and effective: bring down one leg.

The first thing to do is to determine the position of the breech in relation to the pelvis. In all cases of doubtful diagnosis it is well to pass the fingers, or hand if necessary, well into the pelvis, so as to reach the higher presenting parts. In a breech case we thus reach the trochanters, and above them the groins, where a finger will pass between the child's body and the thigh flexed upon it. Then in front will be the fissure between the thighs; and here, if the legs are flexed upon the thighs, will be the feet to remove all doubt. These are what we are in search of. We only want one. It is much more easy to bring down one foot, and it is, moreover, more scientific. The question now comes, Which foot to bring down? The one nearest to the pubic arch is the best. To seize it, pass the index finger over the instep; then grasp the ankle with the thumb, and draw down backwards to clear the

Fig. 206.



Showing how to seize a foot, to decompose the wedge formed by the extended legs and trunk. (R. B.)

symphysis pubis. When the leg is extended outside the vulva, it will be found that traction upon it will cause the half breech to descend and the child's sacrum to rotate forwards. The further progress of the case falls within the ordinary laws of breech labor (see Fig. 205).

The second case—that in which the feet lie at the fundus of the uterus close to the face—is far more difficult. The wedge formed by the extended legs and the upper part of the trunk must, in some instances at least, be decomposed before delivery can be effected. The cause of the difficulty will be understood on looking at the diagram (Fig. 206), and on reflecting that the breech or wedge may in great part be driven low down into the pelvis, leaving but little space for the operator's hand to pass; further, that the hand must pass to the very fundus of the uterus to reach a foot. No ordinary case of turning involves passing the arm so far.

The mode of proceeding is as follows: Place the patient on her side (see Fig. 206); produce anæsthesia to the surgical degree; support the uterus with the right hand on the abdomen; pass the left hand into the uterus,

a part of the pelvic cavity sometimes, by the breech, render it
one of considerable difficulty, demanding great steadiness and
We have on several occasions brought a live child into the w

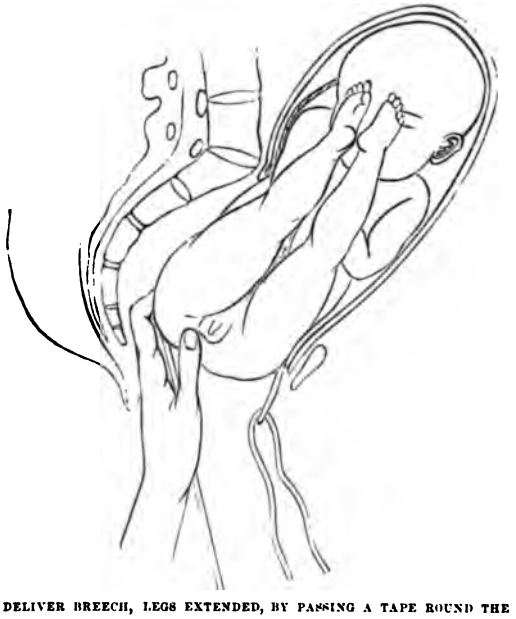
FIG. 207.

SHOWING THE WEDGE DECOMPOSED WHEN ONE LEG IS BROUGHT DOWN. (R. B.)

extended along the child's body so as to have a foot over each shoulder, which much increases the difficulty. In this case each leg must be taken separately and the knee bent." But it is superfluous trouble to take both legs; one is easier and better.

It is quite excusable before proceeding to so difficult an encounter to try some other method. The child may be small and the pelvis large, and so a moderate degree of tractile force may be enough to bring the wedge through without decomposing it. Various manœuvres have been adopted. You may hook one finger in a groin, and draw down; or, what we have found better, you may with the forefinger *hook down each groin alternately* (see Fig. 208). In this way the breech will sometimes move, and when it is delivered, the wedge may be decomposed outside the vulva by flexing and bringing down one leg. Or a piece of tape or other soft cord may be passed over the groins, as Giffard did. An apparatus such as a flexible catheter might be used to

FIG. 208



SHOWING HOW TO DELIVER BREECH, LEGS EXTENDED, BY PASSING A TAPE ROUND THE THIGHS. (R. B.)

carry the string over the hips, after the manner adopted to plug the posterior nares for epistaxis (see Fig. 208). Ramsbotham recommended the slipping a silk handkerchief over the groins. But it is very likely that these and like measures may fail; and by the extent to which they may have succeeded in bringing down the breech, by so much is the difficulty increased. The wedging is tighter; there is nothing left but to decompose the wedge. And this, we repeat it emphatically, is the right thing to do in the first instance.

It must, however, be noted that some men of high authority advocate the use of the forceps to the breech. Certainly in some cases it answers well. Professor Harvey, of Calcutta (1884), contends that the forceps should be tried in extreme cases. Special forceps have been devised to fit the breech.

Whenever traction is made, and especially when rotation of the child on its axis is made by the operator, there is great risk of the arms hitching on the edge of the pelvic brim and running up by the sides of the head. The

way of getting over this difficulty will be explained when describing version for transverse presentations. When the breech and trunk are delivered, the arms and head may follow with the aid of slight guiding force; and it is important, in the child's interest, that the slightest possible traction force be used. If, however, we feel no pulsation in the cord, and there be convulsive twitching of the legs with spasmodic heaving of the chest, there is no time to lose; the delivery must be accelerated. This may be done in one of two ways: First, we may hook two fingers of one hand over the shoulders, whilst, the other hand holding the legs, we exert traction in the direction of the axis of the pelvis; but if this manœuvre do not succeed readily, it is better to use the forceps in the manner described on the application of the forceps to the after-coming head.

Difficult Twin-labors.

Amongst the most puzzling cases requiring operative interference are certain cases of twins. The ordinary history of twin-labor has been sketched. Commonly, as we have seen, the embryos are lodged each in its own bag of amnion and chorion (see Fig. 153), and are so packed that when labor occurs one presents at a time in the pelvic brim and traverses the pelvis before the other fruit-sac is ruptured. Thus the fœtuses do not get in each other's way.

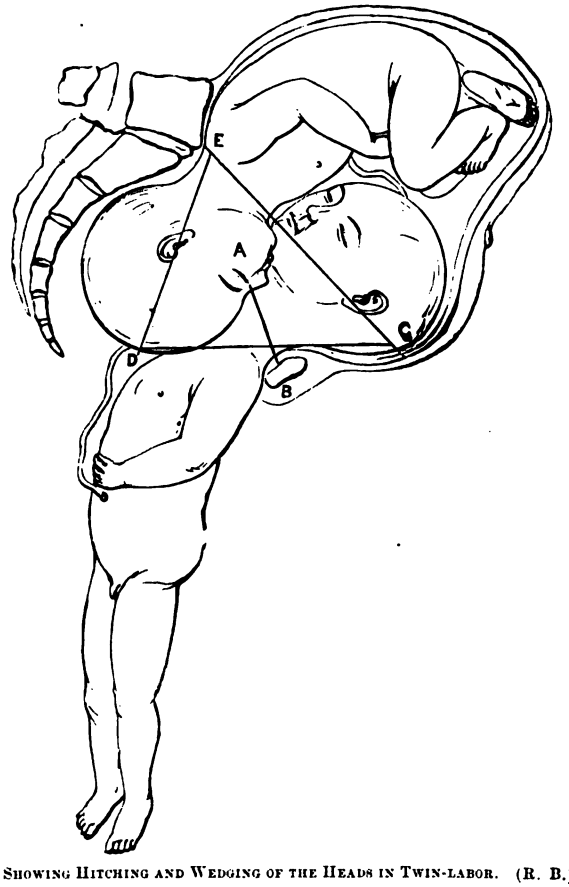
The labor is apt, however, to be lingering from over-distention of the uterus, and the birth of the second child may be delayed. The advance of the first child is apt to be slow, because the driving force has to be transmitted through the medium of the amniotic sac of the second child. Whether we suspect twins or not, the indication for the forceps to deliver the retarded head in the pelvis is clear. A very little *vis à fronte* may be enough. Then comes the question, what to do with the second child. Shall we expedite its delivery, or leave it for the natural power to expel? When expectation has been the course adopted hours, even days, have elapsed before the second child was born. Want of power is the usual cause of delay; the nerve-store has been exhausted in the effort of delivering the first child. Want of power is a cogent reason for giving help; it is not wise to leave an inert uterus and an exhausted system to struggle alone. David Davis frequently saw flooding ensue in the practice of those who waited after the birth of the first child. The judicious course is to allow a moderate time, say half an hour, for the system to rally from the first labor, and then to help the second labor. Immediately after the expulsion of the first child, apply the binder firmly to support the uterus. If the membranes bulge through the os uteri, rupture them, and at the same time increase the pressure on the fundus uteri. If effective uterine action arise, let the uterus do its work; but if deficient, apply the forceps if the head present. Be careful to follow down the child by external pressure, squeezing the child out, as it were.

When the embryos are both lodged in the same sac—that is, in one common chorion and amnion—awkward complications may arise. Before or during labor the limbs and heads may become so entangled or locked as to form one mass, which is too large to pass through the pelvis. The embryos may perform the most remarkable evolutions; cases have been known where one embryo has dived through a loop in the other's umbilical cord, and knots have been formed involving the two cords.

The most common form of locking occurs through the hitching of one head under the chin of the other; and this may happen whether both children present head-first, or one by the breech, the other by the head. The latter case appears to be the more frequent. A child appears by the feet or breech; and when born as far as the trunk or arms, it is found that the labor does

proceed, and on making traction to accelerate delivery, unexpected stance is felt. You pull, but the child sticks fast in the pelvis. The first ɔicion is, probably, that the head is too large, or that the arms have run by the sides of the head, wedging it in the brim. You liberate the arms pull again, and still the head refuses to move. Renewed examination ɔw made. We may get information in two ways: First, under anæsthesia, ı the left hand into the pelvis, so as to reach above the child's breast, feeling its chin or mouth. Instead of feeling this first, we may be surprised at ting a hard, rounded mass (see Fig. 209) jammed in the neck and chest

FIG. 209.



SHOWING HITCHING AND WEDGING OF THE HEADS IN TWIN-LABOR. (R. B.)

he presenting child, which can hardly be anything else than the head of ther child which has got in the way. Secondly, by external palpation we ɾ succeed in making out through the abdominal wall the head of a child ve the symphysis pubis, inclined to one or other side, in a position which ɾelation to the trunk partly born, and to the head which we have felt whilst loring the interior of the pelvis, will satisfy us is the head of the first child. ɾther palpation will trace the trunk and breech of the second child.

f the children are small they may, with more or less difficulty, come ɔugh the pelvis together in this fashion. Sometimes it has been possible

to seize the second head by the forceps, and to extract it without disturbing the first child. But if the children be at all large, this proceeding is not likely to save them. The pressure to which both must be subjected is too hazardous; even with children below the average size, the head of the second resting on the chest and neck of the first form a wedge too large to clear the brim. We get the state of things represented in Fig. 209. D is the apex of the wedge driven into the pelvis; E C is the base too large to enter; A is the point at which the wedge may be decomposed.

The problem before us is how to extricate one head from the other so as to allow one child to pass at a time. There are several methods of accomplishing this. But before deciding upon one, it is well to study how the children are affected by the complication. Is one child in greater jeopardy than the other? If so, which? If we find that the situation involves extreme peril or death to one child, we shall not hesitate to mutilate this one, if by so doing we secure or promote the safety of the other.

1. The first thing to try is to disentangle the heads without mutilating either child. It is still possible that both may be born alive. The patient being anæsthetic, the operator presses back the trunk into the pelvis as much as possible, so as to lift the two heads off the brim, and so to loosen the lock. Then by external manipulation, aided by a hand in the pelvis, we try to push the heads apart in opposite directions. If we succeed in unlocking them, the head of the second child is held out of the way, whilst the operator or an assistant draws down the body of the first child, and engages its head in the pelvis. If this be accomplished the difficulty is over.

2. Experience shows that the first child, whose trunk is partly born, encounters by far the greater danger. Its umbilical cord is likely to be compressed; its neck and chest are forcibly squeezed. On the other hand, the cord of the second child is comparatively safe, and the pressure upon its neck is less severe. We may, moreover, find by feeling the cord of the first child that it is pulseless and flaccid; that tickling its feet excites no reflex action; and the finger on the chest may feel no heart-beat. Having thus determined that there is but faint or no hope for the first child, we turn to the best means of rescuing the second. We may decompose the wedge formed by the two heads by detaching the head of the first. This is done by drawing the body of the first child well backwards, so as to bring its neck within reach. Held in this position by an assistant, the fingers of the left hand are passed into the pelvis so as to hook them over the neck and serve as a guide to Ramsbotham's or Braun's decapitator, or the wire-écraseur. If these are not at hand, the task can be accomplished by strong scissors (see Fig. 209). A B represents the line of decapitation.

As soon as the neck is severed, the trunk will be extracted by traction easily enough. The loose head will then slip up or on one side, or can be made to do so by passing the hand inside the uterus. If the head of the second child do not descend by the spontaneous action of the uterus, it may be seized by the forceps, or we may seize a leg and turn. The head of the first child will follow last of all. If it offer any difficulty, it may be dealt with in the manner described hereafter in the section, "How to deal with the detruncated head left in utero."

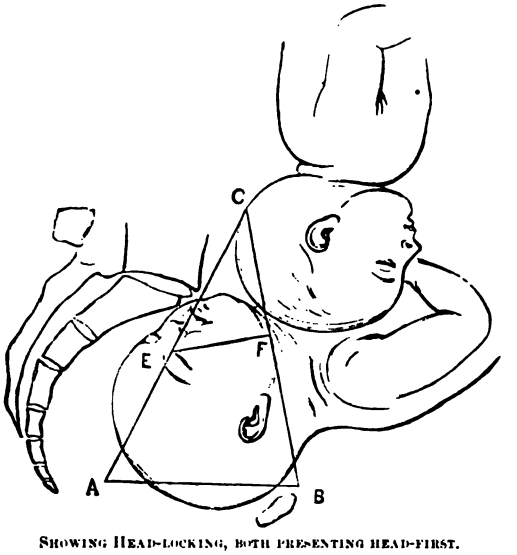
3. If there be reason to conclude that the child is dead, it would be justifiable to perforate its head, and lessen its bulk by help of the crochet. This is another mode of breaking up the base of the wedge. The head will then flatten in and permit the trunk and head of the first child to be delivered.

In the case of head-locking (see Fig. 210), where the head of the first child presents and gets locked by the head of the second, a similar rule of action will apply. The heads may be disentangled by external and internal

manipulation. Failing this, we may seize the foremost head by the forceps, and whilst an assistant pushes away the second head, we can extract the first child. A good case in which this plan succeeded is related by Graham Weir.[1]

Another rule should be observed. When the first child is born, do not pull upon the cord, or you may do mischief in two ways. It is possible that the cord may be entangled round the neck or a limb of the child *in utero*, or the cord of the child *in utero* may be entangled in it, so that by pulling on the first cord you may strangle the second child, or arrest the circulation in its cord; or you may detach the placenta prematurely, thus giving rise to

FIG. 210.



SHOWING HEAD-LOCKING, BOTH PRESENTING HEAD-FIRST.

A. Represents apex of wedge. B. C. The base. E F. The line of decomposition of wedge by removal of the upper head.

hemorrhage; and in the probable event of the placenta being united or common, again imperilling the child *in utero*. It is better if the cord becomes tight, so as to drag on the umbilicus, to divide it without attempting to tie the cut ends.

DORSAL OR NUCHAL DISPLACEMENT OF AN ARM.—Sir James Simpson and Cazeaux drew attention to a curious cause of dystocia. An arm may slip up and become locked behind the neck (see Fig. 211). As the difficulty is to be met by altering the position of the displaced limb, it comes under our definition of turning.

This displacement most commonly occurs in cases of podalic or breech-labor, as after turning. We are inclined to think that it is most frequently produced by unskilful manipulation. It is a consequence of the error of rotating the child upon its axis during extraction. The trunk revolving under this manipulation, the arm is caught against the wall of the uterus, and under excess of friction does not move round with the trunk, but comes to be applied to the nape of the neck. Dugès and Cazeaux explain that

[1] Edin. Med. Journ., 1860.

this may happen in two ways. First, the arm may cross behind the nucha after having been raised above the head; the crossing then takes place from above downwards, and from before backwards, relatively to the fœtus. Secondly, it may take place from below upwards, the arm rising on the back of the fœtus, and being arrested below the occiput. The arms are habitually placed by the sides of the chest. In rotating, the attempt is made to carry the abdominal aspect of the child towards the loins of the mother; the trunk alone moves; the arm, therefore, remains behind; the operator in performing extraction draws the trunk down; the arm is caught by the symphysis pubis, where it is detained until the nucha comes down to clench it. This displacement, therefore, is produced by too much diligence. Those who anticipate Nature, thwarting her operations, must be prepared for the consequence.

Let us extract light from our error. We must retrace our steps. By rotating the child back in the contrary direction so as to restore the original

FIG. 211.

NUCHAL DISPLACEMENT OF THE ARM. (R. B.)

position, we may possibly liberate the arm. At any rate, further necessary proceeding will be easier. Carry the trunk backwards so as to give room to pass the forefinger in between the symphysis and the child's shoulder; then hooking on the elbow, draw this downwards and then forwards. It may be useful as a preliminary step to gain room by first liberating the other arm.

If the arm cannot be extracted, it may be necessary to perform craniotomy.

In Simpson's case the head presented. It is not easy to imagine how the hand of a living child can get behind the neck when the head presents. Simpson suggests that this occurs more frequently than is suspected, and that it accounts for many cases of arrest of the head where there is no dis-

proportion, and which resist even traction by forceps. He recommended to bring down the hand and arm forward over the side of the head, converting the case into one of simple presentation of the head and arm. Or recourse might be had to turning, as was done successfully by the late Jardine Murray.[1]

Dystocia from Excessive Size of the Abdomen of the Fœtus.—This may happen from dropsy, from enlarged kidneys or liver. In some of these cases the abdomen may burst, or be originally defective, so that the intestines will prolapse. Such a condition, if not produced deliberately by the surgeon, may puzzle extremely. The procident intestines may be taken to be those of the mother, and lead to the conclusion that there is rupture of the uterus. Or, on the other hand, where there has actually been rupture of the uterus or vagina, with protrusion of intestines, these may, under circumstances disturbing the surgeon's judgment, be assumed to belong to the child, and be cut away.

The case is diagnosed presumptively, if the head presents, by the arrest of labor, the head refusing to yield under traction by forceps. After reasonable trial in this way, to avoid exhaustion on the part of the mother, or rupture, craniotomy becomes necessary. Even then the delivery is arrested.

Then passing the hand into the uterus, the child's abdomen, distended beyond measure and giving the feel of a large tense sac containing fluid, the real obstacle is determined.

We may then puncture its abdomen with a long trocar, or even rip it open by the crotchet. The easiest way to deliver after this is to bring down the feet.

If the breech or feet present, the diagnosis and treatment are easier. Pulling on the legs causing no advance, the hand passed into the uterus ascertains the nature of the case. Puncture quickly reduces the obstacle. We have been called to cases of both kinds.

Dystocia from Monsters.

It is convenient in this place to consider the mode of delivery of monsters. Double monsters may give rise to difficulties like those which occur in delivery of twins. In many cases, Nature is able to deal with them. They are most frequently dead or possessed of little vitality, a circumstance not usually much regretted. The death is often the result of the mode of birth, one part of the monster pressing injuriously upon another. If in any case of obstructed delivery it could be with certainty diagnosed that the cause of obstruction was a monstrous embryo, the indication commonly accepted to do our best to save the mother, even at the cost of destroying the embryo, is enhanced. But this cannot always be known in time to influence our proceeding. As in the case of locked twins, we are therefore led to postpone mutilation, in the hope that the delivery may be effected without.

Playfair has discussed this subject in an excellent memoir.[2] He divides monsters, according to their obstetric properties, into four classes:

A. Two nearly separate bodies are united in front by the thorax, or abdomen. In this case the feet or heads may present. The most favorable presentation appears to be the feet. The trunks come down nearly parallel The arms can be liberated without much trouble. It is when the heads come to the brim that the difficulty arises. The object is to get one head at a time to engage in the brim. This has been done successfully by Drs. Brie and Molas.[3] When the shoulders were born, the bodies were carried strongly

[1] Med. Times and Gaz., 1861.
[2] Obst. Trans., vol. viii.
[3] Bull. de la Faculté de Méd., vol. iv.

forwards over the mother's abdomen. This manœuvre has the effect of placing the two heads on a different plane, bringing the posterior head lower than the anterior one, which for the time is fixed above the symphysis. When the posterior head is in the pelvis, traction then will bring it through, and the second head will follow. If not, either the first or the second head can be detruncated by Ramsbotham's hook, or by scissors or knife. The command thus obtained over the course of labor in podalic presentations renders it desirable to turn if the heads present.

But sometimes when the heads present, accommodation takes place, which permits them to pass without mutilation. Thus Mr. Hanks reports[1] a case in which one head got packed between the shoulder and head of the other body, so that both passed without great difficulty. One head is born first, either by aid of forceps or spontaneously, and the corresponding body may be expelled by a process of doubling-up, or spontaneous evolution. If this does not proceed with sufficient readiness, decapitation or craniotomy of either the first or second child must be practised.

B. Two nearly separate bodies are united nearly back to back by the sacrum, or lower part of the spinal column. In this case the mode of delivery is essentially the same as in A.

C. Dicephalous monsters, the bodies being fused together. One head will come down first. The body follows by doubling or spontaneous evolution. If this does not take place, decapitate the first head and bring down the feet.

D. The bodies are separate below, but the heads are partially united. Whether the head or feet present, if there is obstruction, it is best to perforate the head.

Labor with *single monsters*, especially the *acephalous* monsters, is not only at times puzzling, but is apt to be protracted. The diagnosis is apt to perplex. We are not accustomed to feel a head divested of cranial bones. The labor is generally protracted. Hemorrhage is likely to complicate. The protraction is due to the absence of a fully developed skull. As the uterus presses upon the child the body doubles up itself, the back of the neck becoming the presenting part. In fact, an acephalous fœtus acts like a dead fœtus in retarding labor. The forceps may serve, but turning will generally be preferable.

The varieties of monsters described by Noble Smith have been considered. In labor, they may simulate almost every complication. Tumors as big as the head itself may be attached to the head or sacrum. The limbs may be double or truncated. Such anomalies may defy diagnosis before or during labor.

Hernia, femoral or inguinal, complicating pregnancy may not seriously obstruct the progress of labor, but may prove a source of danger to the mother. A coil of intestine might get compressed against the pelvis by the descending child. A similar danger might also result from vaginal hernia. Reduction should always be effected during pregnancy. The same observations apply to umbilical hernia. This generally results from the separation of the recti muscles in a former labor, or from the widening of the scar after ovariotomy. A well-adapted abdominal belt should be worn during pregnancy and labor to compensate for the deficiency in the normal support and action of the abdominal muscles, as well as to guard against the protrusion and injury of the intestines.

[1] Obst. Trans., vol. iii.

Podalic Bipolar Turning.

The conditions indicating this operation are: 1. Generally those which are not suited for head-turning, or for the imitation of spontaneous evolution. 2. Especially those cases of oblique presentation, in which the breech, knees, or feet are nearer to the os uteri than is the head. 3. Cases in which the shoulder has entered the brim of the pelvis, and especially those in which the arm is prolapsed. 4. Most cases in which the cord is prolapsed with the arm or hand, and cannot be returned or maintained above the presenting part of the child. 5. Cases of shoulder presentation in which the liquor amnii has drained off, and in which the uterus has contracted so much as to impede the mobility of the fœtus. 6. Certain cases in which it is desirable to expedite labor on account of dangerous complications, present or threatening: as hemorrhage, accidental or from placenta prævia; convulsions. In these cases it is indifferent what the presentation may be. But the forceps would be preferred if promising equal expedition. 7. Some cases of inertia, the head presenting, as in pendulous belly and uterus, where the head cannot be grasped by the forceps. 8. Certain cases of face presentation. 9. Certain cases of minor contraction of the pelvis, which are beyond the power of the forceps, and which ought not to be given over to craniotomy. 10. Certain cases of morbid contraction of the soft parts. 11. As a part of the proceedings for the induction of premature labor, in certain cases in which the pelvis is contracted, or other circumstances do not permit the spontaneous passage of the child with sufficient quickness to secure a live birth. 12. Some cases of craniotomy, as the readiest mode of extracting the fœtus. 13. Certain cases of rupture of the uterus, the child being still in the uterine cavity. 14. Certain cases of monstrosity of the fœtus. 15. Certain cases of dystocia from tumors encroaching on the pelvis. 16. Certain cases of death of the mother during labor, in the hope of rescuing the child, when the Cæsarean section cannot be performed.

It is thus seen that version has a wide range of application, and that in a considerable number of instances it stands between the forceps and craniotomy, being in some cases competitive or elective in relation to these two operations, whilst it has a large field of its own.

In artificial podalic version we take as our guide, and seek to imitate, the spontaneous podalic version. We now examine the *conditions favorable to this operation*. These are: 1. The pelvis must be capacious enough to permit the passage of the fœtus without mutilation. 2. The vagina and vulva must be dilated, or dilatable enough to permit the necessary manipulations on the passage of the child. 3. The pelvis must not be too crowded with the child. 4. The uterus must not be contracted to such an extent that the fœtus has been in great part expelled from its cavity, so that the presenting shoulder or head cannot, without undue force, be pushed on one side into the iliac fossa.

If the shoulder is free above the brim, the hand not descended, it will be easy to push it across to the nearest iliac fossa. *If the shoulder is movable*, even if the hand has fallen into the vagina, the operation is practicable, often not even difficult. The presence of a little liquor amnii is a manifest advantage, since, so long as this is the case, there can be no balling or impaction.

If, on the other hand, the shoulder has been driven low down into the pelvis, near the perineum, the body being firmly compressed into a ball by the spasmodic contraction of the uterus, the child is almost certainly dead, and turning may be difficult or impossible without extreme danger to the

mother. This is a strong indication for imitation of the process of spontaneous evolution.

The Operation.—It is convenient to take first the more simple order of cases in which turning is indicated on account of conditions involving danger to the mother, as hemorrhage from placenta prævia, the head presenting, and the cervix uteri sufficiently dilated. A case of this kind—the forceps not being preferred—requires *complete turning*, and therefore best illustrates the mechanism of the bipolar method.

We must, *in limine, distinguish between turning and extraction.* We will assume a case in which both proceedings are necessary.

Each proceeding may be divided into stages or acts. The *successive acts in turning* are: 1. The removal of the presenting part of the child from the os uteri, and the immediate placement there of the knees. 2. The seizure of a knee. 3. The completion of version by the simultaneous drawing down of the knee and the elevation of the head and trunk. These three acts complete turning.

The several acts in extraction are: 1. The drawing the legs and trunk through the pelvis and vulva. An incidental part of this act is the care of the umbilical cord. 2. The liberation of the arms. 3. The extraction of the head.

Preparatory Measures.—The bowels are emptied by enema. The catheter is passed. Anæsthesia is induced if difficulty is anticipated; but in the simpler cases of bipolar turning it is not an essential condition. Where there is any disposition to convulsion, we prefer nitrite of amyl. The patient lies on her left side, the nates brought to the edge of the bed; the pillows are removed so that the head and shoulders fall to the same level as the nates. The head is directed towards the middle of the bed, so that the operator's arm may not be twisted during manipulation; the knees are drawn up; and the right knee is held up by an assistant, so as not to obstruct or fatigue the operator's right hand, which has to pass between the thighs to work on the surface of the abdomen.

To facilitate the passage of the hand is the first object. The hand is opposed —first, by the muscles of the vulva and vagina, the levator ani, and the sphincter. These contract spasmodically when the attempt is made to introduce the hand. Secondly, the cervix uteri may oppose in like manner. The difficulty is overcome by anæsthetics and by free lubrication with carbolized vaseline or oil. In some of the simpler cases under discussion, it is not even necessary for the hand to pass the vulva. Two fingers reaching the presenting part are enough.

The state of the cervix has to be considered. It is one of the natural consequences of a shoulder presentation that the cervix is but rarely found dilated enough for turning and delivery until after, perhaps long after, the indication for turning has been clearly present. A shoulder will not dilate the cervix properly. The same may be said of many cases where turning is indicated by danger to the mother, as from convulsions or hemorrhage. To wait for a well-dilated cervix might be to wait until the child or mother is dead. It follows, therefore, that we must be prepared to undertake the operations at a stage when the cervix is imperfectly dilated.

What is the degree of dilatation necessary? If the question be simply one of turning, it is enough to have a cervix dilated enough to admit the passage of one or two fingers only. But since the ulterior object is delivery, with the birth of a live child if possible, we must have a cervix dilated enough to allow the trunk and head of the fœtus to pass without much delay. The modes of dilating the cervix have been described (see Fig. 179). The object is attained chiefly by the hydrostatic bags, or by the

hand. The bags are much to be preferred. The hand cannot effect the dilatation so gently, and it is apt to get cramped, and lose its delicacy of touch.

The average obstetric hand will easily traverse a cervix that is too small to allow the head to pass, so that after all, even in head-last labors as in head-first labors, the head must generally open up the passages for itself.

The presence of liquor amnii is a matter of accident. If any be present, so much the better. It is needless to say that the fœtus will revolve more easily if floating in water; but it must not only revolve, we have to seize a limb. At some time or other, therefore, the membranes must be ruptured. What is the best time to do this? If we are proceeding to turn by the old method—that is, by passing the whole hand into the uterus before seizing a foot—it is an advantage to follow the plan recommended by Peu, of slipping the hand up between the uterine wall and the membranes until you reach the feet, and then to break through and seize them. During this proceeding, the arm plugging the os uteri retains at least a portion of the liquor amnii, and on drawing down the legs the body revolves usually with perfect facility.

But if we are proceeding to turn by the bipolar method, with a cervix perhaps imperfectly opened, the membranes must be pierced at the os uteri. In this case you may, perhaps, accomplish the first act in version, that of removing the head or shoulders from the brim, and of bringing the knees over the os whilst the membranes are intact. This can be tried first, only rupturing the membranes when we are ready to seize the knee. But sometimes excess of liquor amnii imparts too great mobility to the child. The moment we touch the child it bounds away as in *ballottement*. In such a case it is better to tap the membranes first, and allow a part of the liquor amnii to run off. Whilst doing this, the finger is kept on the presenting part to ascertain how its position and mobility are affected by the escape of the water and the contraction of the uterus, so as to seize the right moment for proceeding.

It is of great importance to use the left hand for the internal part of the operation. It is a case in which ambidexterity is eminently required. The left hand in most people is smaller than the right. The patient lying on her left side, it follows the curve of the sacrum more naturally than could the right. It assists the right hand working outside, the two working consentaneously, involving no awkward or fatiguing twisting of the arms or body.

The First Act.—Introduction of the hand. Bring the fingers together in the form of a cone; pass in the apex of this cone, gently pressing backwards upon the perineum, and pointing to the hollow of the sacrum. If the presenting part is fairly reached by the tips of the fingers, without passing the hand into the vagina, this may be enough, but most frequently the whole hand must be introduced. We assume the case to be one of head presentation, since this involves complete version, the proceeding we want to illustrate. The tips of the fingers are passed through the os uteri to the presenting part. We then ascertain to which side of the pelvis the occiput is directed, for it is to that side that we must send the head. At the same time, an assistant holding up the woman's right knee, the right hand is spread out over the fundus uteri, where the breech is. Now begins the simultaneous action upon the two poles of the fœtal ovoid, the fingers of the hand inside pressing the head-globe across the pelvic brim towards the left ilium, the hand outside pressing the breech across to the right side and downwards towards the right ilium (see Fig. 212). The movements by which this is effected are a combination of continuous pressure and gentle taps with the finger-tips on the head, and a series of half-sliding, half-pushing impulses

with the palm of the hand on the breech. Commonly, we may feel the firm breech through the abdominal walls under the palm, and this supplies a

FIG. 212.

REPRESENTS FIRST STAGE OF BIPOLAR PODALIC TURNING. (R. B.)

The right hand on the fundus pushes the breech to the right, and downwards, as indicated by the arrow. The left-hand fingers push the head to the left ilium, away from the brim.

FIG. 213.

REPRESENTS THE SECOND STAGE OF THE FIRST ACT. (R. B.)

The right hand still at the fundus uteri, depresses the breech, so as to bring the knees over the brim, while the left hand pushes the shoulder across the brim towards the left iliac fossa.

point to press against. A minute sometimes, seldom much more, will be enough to turn the child over to an oblique, or nearly transverse, position, the head quitting the os uteri, and the shoulder or chest taking its place. It is important at this juncture to keep the breech well pressed down, so as to have it steady whilst we attempt to seize a knee (see Fig. 213). This is the time to puncture the membrane, if not already broken. The fingers in the os uteri are pressed through the membranes during the tension caused by a pain, and we enter upon the *second act, the seizure of a knee.* Which knee to seize is the first question. The knee that effects the readiest disposition of the child's back forwards, producing a dorso-anterior position, is the best to seize. In the case before us, the anterior knee is the one best adapted to effect our purpose. Reference to the figures will show that the legs doubled up on the abdomen bring the knees near the chest, so that as soon as the head and shoulder are pushed on one side the knees come near the os uteri. The knee being seized, the further progress of the case is under command. By simply pressing down upon the part seized, version may often be completed. But it will greatly facilitate the operation to apply force to both poles. It is seen in Fig. 213 that the hands have changed places in relation to the two poles of the fœtal ovoid. Although the left hand has never shifted its position from its part in the vagina, the ovoid has shifted. The forefinger drawing down the knee now acts upon the pelvic end of the ovoid. The right hand, therefore, is at liberty to quit this end; it is transposed to the head end of the ovoid, which has been carried over to the left iliac fossa. The palm is applied under the head, and pushes it upwards in response to, and in aid of, the downward traction exerted on the child's leg. This outside manœuvre singularly facilitates the completion of version. It may be usefully brought into play in almost every case of podalic turning. If it is neglected we may fail to effect complete version, for the head will not always quit the iliac fossa by simply pulling on the legs.

THE THIRD ACT. COMPLETION OF VERSION.—Continuing to draw upon the leg, as soon as the breech nears the brim, a movement of rotation of the child on its long axis takes place, the end of which is to bring its back to the front of the mother's pelvis. This rotation depends upon a natural law of adaptation of the two parts. It is bad practice to "give the turns," as some authors imagine they do. We cordially agree with Wigand when he says, "Nature knows better than we do how to impart the proper turns." What we have to do is simply to supply onward movement in the pelvic axis. Nature will do the rest. The leg will be felt to rotate in our grasp, and the back will gradually come forward (Fig. 214).

This completes version. The breech is substituted for the head. Nature, aided or not by pressure on the fundus, may effect expulsion. But if she fail, we have it in our power to effect delivery by extraction. We assume that extraction is necessary, and proceed to this operation.

THE OPERATION OF EXTRACTION AFTER PODALIC TURNING, OR OTHER BREECH-FIRST LABOR.—We possess in our hold upon the leg a security for the further progress of delivery of which we can avail ourselves at pleasure. Extraction is conveniently divided for the purpose of description into three acts: (1) Drawing down the trunk through the vulva; (2) the liberation of the arms; (3) the extraction of the head.

THE FIRST ACT is effected by simply drawing down upon the extended leg in the axis of the brim. Here again we must insist upon the rule to use traction simply, avoiding rotation. This is attained by holding the limb loosely in the hand, that the limb may rotate within the grasp under the rotation imparted to it by the trunk. Care must also be taken to avoid all premature attempts to direct the extracting force forwards in the axis of the pelvic outlet.

When the breech has come to the outlet, it is time to direct the extracting force a little forwards, so as to enable the hip which is nearest the sacrum to clear the perineum. This stage should not be hurried. The gradual passage of the breech has been doing good service in securing free dilatation of the vagina and vulva, an essential condition for the easy passage of the shoulders and head. When the hips have cleared the outlet, the forefinger of the left hand may be passed into the groin, and gentle extraction made by this additional hold, thus distributing the traction-force and lessening the drag upon one medium, the leg. At the same time, by pressing the knee still in the pelvis across the child's abdomen, the liberation of this leg is facilitated.

FIG. 214.

REPRESENTS COMPLETION OF THIRD ACT OF TURNING, AND THE BEGINNING OF THE FIRST OF EXTRACTION. (E. S.)

The right hand still supports the head, now brought round to the fundus uteri. The left hand draws down on the child's leg in the direction of the pelvic axis. The child's back has come to the front of the pelvis. If *extraction* is necessary, both hands work together, one for traction, the other for pushing.

When both legs and the breech are outside the vulva, we have acquired a considerable increase of extracting power. But it is necessary to use it with discretion, and to lessen the force exerted upon any part by distributing the force as much as possible. Thus, we first draw upon both legs, holding them at the ankles, a soft diaper interposed. Secondly, the other hand lightly grasping the thighs or the child's pelvis and exerting gentle traction. At this stage, pressure on the fundus uteri, pressing the child down, diminishes the traction-force.

Traction must now again be directed in the axis of the brim, in order to bring the shoulders through the inlet. The shoulders will enter in the same oblique diameter, back forwards, as that in which the breech traversed.

As soon as the belly comes into view, the cord demands attention. The

management of this point is described at p. 536. The observations of May and Wigand are important. Reasoning that the pressure suffered by the cord affects the veins more than the arteries, and hence that the access of blood to the fœtus is hindered, whilst the removal of blood from it is still obstructed, so that a fatal anæmia results, they advise to tie the cord, as soon as the child is born as far as the navel, and then to complete extraction. Von Ritgen says that when this is done there is little need to hurry the extraction.

THE SECOND ACT COMPRISES THE LIBERATION OF THE ARMS.—In the normal position of the fœtus the arms are folded upon the breast; and if the trunk and shoulders are expelled through a normal pelvis by natural efforts, they will commonly be born in this position. But if ever so little traction-force is put upon the trunk, the arms, encountering friction against the parturient canal, as the body descends, are detained, and run up by the sides of the head. Hence often arises delay in the descent of the head. It is wedged

FIG 215.

REPRESENTS THE MODE OF LIBERATING THE SACRAL OR HINDER ARM. (R. B.)

in the brim. To avoid this complication is one great reason for not putting on more extraction-power than necessary. If, however, we find the arms in this unfortunate position, we must be prepared to release them promptly, and at the same time without injury. It is very easy to dislocate or fracture the humerus or clavicle if the proper rules are not observed.

The cases vary in difficulty, and therefore in the means to be adopted. In some cases the arms do not run up in full stretch along the sides of the head. The humeri are directed a little down, so that the elbows are within reach. In such cases it is an easy matter to slip a forefinger on the inner side of the humerus, to run it down to the bend of the elbow, and to draw the forearm downwards across the chest and abdomen, and thus to bring the arm down by the side of the trunk.

The cardinal rule in all cases is to observe the natural flexions of the limbs, always to bend them in the direction of their natural movements. The arms, therefore, must always be brought across the breast. The way to do this is as follows: Slip one or two fingers up along the back of the child's thorax, and bend the first joints over the shoulder between the acromion and the

neck; then slide the fingers forwards, catching the humerus in their course, and carrying this with them across the breast or face. This movement will restore the humerus to its natural flexion in front of the body. The operator's fingers continuing to glide down, will reach the bend of the elbow, and, still continuing the same downward and forward movement across the child's chest and abdomen, the arm is extended and laid by the side of the trunk.

This is what has to be done. But *which arm shall be brought down first!* The most simple rule is to take that first which is the easiest, for when one arm is released, the room gained renders the liberation of the second arm easy enough. Generally there is most room to work in the sacrum; therefore it is better to take the posterior or hindermost arm first.

Two principal difficulties oppose the efforts to release the arms. The first is, to bring the posterior or sacral arm within reach of the finger. To effect this, carry the child's body well forwards, bending it over the symphysis pubis (see Fig. 215). The advantage gained from this is twofold. Space is

FIG. 216.

REPRESENTS THE LIBERATION OF THE PUBIC ARM. (R. B.)

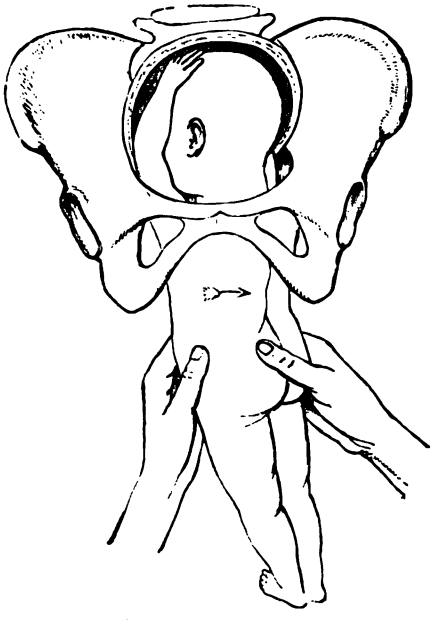
gained between the child's body and the sacrum for manipulation; and as the child's body revolves round the pubic centre, the sacral arm is necessarily drawn lower down, commonly within reach. When the sacral arm is freed, reverse the manœuvre, carrying the child's body backwards over the coccyx as a centre. This brings down the pubic arm (see Fig. 216).

Another manœuvre may be held in reserve, in case the first fail. To execute it, we must still bear in mind the natural flexions of the arms. The child's trunk is grasped in the two hands above the hips, and a movement of rotation is given to the body on its long axis, so as to bring its back a little to the left. The effect of this is to throw the pubic arm, which is prevented by friction against the canal from following the rotating trunk, across the chest (Fig. 217). Thus the effect being accomplished so far, we bring into play the first manœuvre, and bring this arm completely down. This done, the action is reversed by rotating the trunk in the opposite direction. The sacral arm is thus brought to the front of the chest, and, by carrying the trunk back, the fingers will easily complete the liberation.

It is desirable to avoid this rotation, if possible; but under certain circumstances of difficulty it is exceedingly valuable. The rotation need not be considerable; an eighth of a circle is commonly enough; and as it is neutralized by reversal, an objection that might otherwise be urged is removed.

A paramount reason for caution in rotating the trunk or "giving the turns" is this: The union of the atlas with the occipital condyles is a very close articulation; it permits flexion and extension only. The atlas forms with the axis a rotatory joint, so constructed that if the movement of rotation of the head exceed a quarter of a circle, the articulating surfaces are apt to part, and then the spinal cord is compressed or torn. If the chin of the fœtus pass the shoulder in turning backwards, the result may be instant death. We have no doubt that many children have been lost in this way.

FIG. 217.



REPRESENTS A MODE OF LIBERATING THE ARMS. (R. B.)

The trunk is rotated an eighth of a circle from right to left, so as to throw the left arm across the chest.

Sometimes the arm will hitch on the edge of the pelvic brim or just above the imperfectly expanded os uteri. Never attempt, by direct hooking on the middle of the humerus, to drag it through. It would almost certainly be broken. Press it gently against the child's face, and under its chin, bringing the finger down as near the elbow as possible, so as to lift this part, as it were, over the obstruction.

THE THIRD ACT.—The arms liberated, *the extraction of the head* begins. This is often a task of some difficulty, and always demanding strict observance of the laws which govern the mechanism of labor. This act differs from the first two in that whilst these are sometimes effected by Nature, the liberation of the head must frequently be conducted by art. When the head is last, and has entered the brim, it is very much removed from the influence of expulsive force. The uterus can with difficulty follow it into the pelvis,

and the trunk, unless supported by the hands, would, by its mere *vis inertiæ* and friction against the bed, retard the advance of the head. Moreover, this is the stage of chief danger from the compression of the cord. The round head fills the brim and the cervix so that the cord can hardly escape. It would be folly therefore to sit by and trust to Nature at this juncture, at the risk of losing that for which the whole operation has been performed, namely, the child's life.

FIG. 218.

REPRESENTS THE MANUAL EXTRACTION OF THE HEAD. (R. B.)

The dotted line is Carus's curve, the direction to be observed in extraction.

First, let us assume the case of the head being in the pelvis, and that we cannot extract it at once. If we can get air into the chest, which, being outside the vulva, is free to expand, there is no need to hurry the delivery. We may sometimes get the tip of the finger into the child's mouth, and drawing this down, whilst lifting up and holding back the perineum, air may enter the chest. In this way we have kept a child breathing for ten minutes before the head was born. Another plan is to pass a catheter or other tube up into the mouth, so as to give, by means of an artificial trachea, communication with the external air. But we must not put our trust in plans of this kind, lest the golden opportunity be irretrievably lost. The real problem is to get the head out of the pelvis.

There are two principal modes of doing this, whether the head be delayed in the pelvic cavity or at the brim. One is to put on the forceps. This operation, "the application of the forceps to the after-coming head," has been described in the chapter on the forceps. If one is skilled in the use of the forceps, it is little inferior in celerity to the manual extraction, and it possesses the decided advantage of taking off all strain upon the occipito-cervical articulations.[1]

We will, however, describe the proceeding by *manual* extraction. It must be remembered that the head has to perform a double rotation in its progress. It must revolve round the pubic symphysis as a centre; it must rotate in the cavity on its vertico-spinal axis, so as to bring the face into the hollow of the sacrum. In extracting, these movements must be respected. The fingers of one hand are forked over the neck behind, and at the same time holding the legs with

[1] In the third edition of the "Obstetric Operations" the preference is given to manual extraction. But under the advice of Fancourt Barnes, who has had the best results from the axis-traction forceps, this has been reconsidered. We concur in advising the use of the forceps.

the other hand, we draw down gently in Carus's curve (see Fig. 218). If the body is carried forward too soon, the child's head and neck are converted into a hook or cross-bar, which, holding on the anterior pelvic wall, will effectually resist all efforts at extraction.

If the equator of the child's head has not passed the brim, the case is more difficult. Traction must be made in the axis of the brim. Sometimes it requires considerable force to bring the head through; but whilst force will never compensate for want of skill, it is astonishing how far skill will carry a very moderate force, especially if gentle oscillation and firm pressure upon the fundus uteri be made to aid traction.

Turning when the liquor amnii has run off, the uterus being contracted upon the child.

So long as there is any liquor amnii present, and often for some time afterwards, the bipolar method as already described is more or less available. But a period arrives when it becomes necessary to pass a hand fairly into the uterus in order to seize a limb. The contraction of the uterus, especially concentric or centripetal, tends to shorten the long axis of the child's body. The effect is to flex the head upon the trunk, and to bend the trunk upon itself, reducing the ovoid to a more globular form, that is, to "ball the fœtus." The knees are thus brought nearer to the chest, but this does not diminish the difficulty of turning. Secure repose of diastaltic function by chloroform or nitrite of amyl.

The first question to determine is, *which hand to pass into the uterus.* The left hand is generally to be preferred. In the majority of cases the child's back is directed forwards; to reach the legs which lie on its abdomen, the hand must pass along the hollow of the sacrum, and this can hardly be done —the patient lying on her left side—with the right hand, without an awkward twist of the arm. It is scarcely necessary to point out how violent a proceeding it would be to pass up the right hand between the child's back and the mother's abdomen, to carry the hand quite round and over the child's body to seize the feet, which lie towards the mother's spine, and then to drag them down over the child's back. The child perhaps would not turn at all. To avoid this failure, the rule is to pass the hand along the inside or palmar aspect of the child's arm. This will guide the obstetric hand to the abdomen and legs. Or the rule has been stated in this way: Apply your hand to the child's hand as if you were about to shake hands. If the hand presented to you be a right hand, take it with your right, and *vice versâ*.

The following rule will serve in most cases: In all *dorso-anterior positions* lay the woman on her left side; pass the left hand into the uterus; it will pass most easily along the curve of the sacrum and the child's abdomen; the right hand is passed between the woman's thighs to support the uterus externally.

In *abdomino-anterior positions*, lay the patient on her back, and the right hand may be introduced, using the left hand to support the uterus externally. If the patient is supported in lithotomy position, the operator can manipulate without straining or twisting the body. But it is equally easy to use the left hand internally if the patient is on her back. The exception is only indicated to suit those who have more skill and confidence with the right hand.

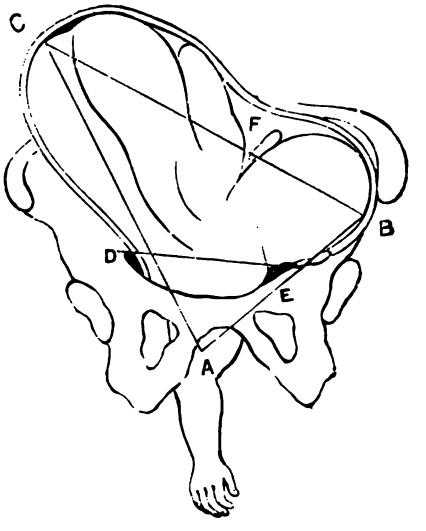
Turning in Dorso-anterior Positions (see Fig. 217).—Introduce the left hand into the vagina along the inside of the child's arm. The passage of the brim, filled with the child's shoulders and the chest, is often difficult. Proceed gently, stopping when the pain comes on. At the same time support the uterus externally with the right hand. Sometimes we may facilitate the passage of the brim by applying the palm of the right hand in the groin to push it up. This will lift the shoulder a little out of the brim. Or we may

adopt a manœuvre attributed to Von Deutsch, but which had been practised by Levret. This consists in seizing the presenting shoulder or side of the chest by the hand inside, lifting it up and forwards, so as to make the body roll over a little on its long axis. This may be aided by pressure in the opposite direction by the outside hand on the fundus uteri, thus getting help from the bipolar principle.

Sometimes advantage is to be gained by placing the patient on her elbows and knees. In this posture gravity helps; the weight of the fœtus, and the lessened retentive force of the abdomen, tend to draw the impacted shoulder out of the brim.

The brim cleared, the hand passes into the cavity of the uterus. This often excites spasmodic contraction, which cramps the hand and impedes its action. Chloroform helps greatly to lessen this difficulty. The hand is spread out flat, and held still until the contraction is subdued. In its progress the hand passes the umbilicus, and the cord may fall in the way. This

FIG. 219.



SHOWING A RIGHT DORSO-ANTERIOR POSITION. (R. B.)

The wedging in the pelvic brim is indicated by A. Apex of wedge. B C Base of wedge two large to enter brim D E.

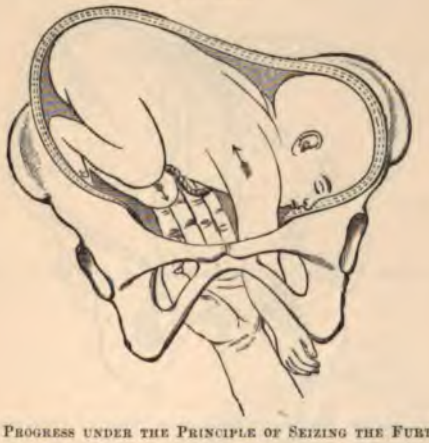
gives an opportunity to ascertain if it pulsates. But we must not despair of delivering a live child because the cord does not pulsate. We have several times had the satisfaction of seeing a live child born when no pulsation could be felt in utero. We are now near the arm and hand. They may perplex. But by keeping well in mind the differences between knee and elbow, hand and foot, we may interpret correctly the sensations transmitted by the parts we are touching. The most characteristic indications of the foot are the ankles and heel. At the umbilicus we are close to the knees. The feet are some way off at the fundus of the uterus applied to the child's breech.

WHAT PART OF THE CHILD SHALL WE SEIZE?—It is still not uncommon to teach that the feet should be grasped. Diagrams copied from text-book to text-book represent this very unscientific proceeding. There ought to be some good reason for going past the knees to the feet, which are further off and more difficult to get at. We know of no reasons but bad ones for taking

this additional trouble. The turning can be accomplished more easily and completely by seizing one knee. Radford insisted upon seizing one foot only. A half-breech is safer than when the two feet come down. The cervix is better dilated. The circumference of the breech is from twelve to thirteen and a half inches, not much less than that of the head. The circumference of the half-breech, one leg being down, is from eleven to twelve inches; whilst that of the hips, both legs being down, does not often exceed ten inches.

But a knee is better than a foot. The proper knee in these cases of impaction is that which is furthest. The reasons are admirably expressed by Sir J. Simpson. We have a right dorso-anterior position, the right arm and shoulder are downmost, these parts have to be lifted out of the brim. How can this best be done? Clearly by pulling down the *opposite knee*, which, representing the opposite pole, cannot be moved without directly acting upon the presenting shoulder. If the opposite knee be drawn down, and supposing the child to be alive, or so recently dead that the resiliency of its spine is preserved, the shoulder must rise, and version will proceed. But if both feet are seized, or only the foot of the same side as the presenting arm,

FIG. 220.



SHOWING VERSION IN PROGRESS UNDER THE PRINCIPLE OF SEIZING THE FURTHER KNEE. (R. B.)
The arrows indicate the opposite lines of movement; how, as the further knee descends, the presenting shoulder rises.

version can hardly be complete, and will perhaps fail altogether. The probable effect is to drag the leg towards the brim, and to increase the wedge and the impaction. It is no sufficient answer to urge that version has been effected by drawing upon the foot of the same side. The rejoinder is that, by it, version in difficult cases is made more difficult. We are entitled to the authority that attaches to experience when we say that, after failing to turn by this method, we have succeeded when abandoning it to seize the opposite knee.

By drawing upon the opposite knee, the movements run parallel in directly opposite directions like the two ends of a rope round a pulley. To turn effectively the child must revolve upon its long or spinal axis as well as upon its transverse axis. Turning, in short, is a resultant oblique movement, between rolling over on the side and the half-somersault. By seizing both legs, this process is marred. The only cases in which we have found it advantageous to seize both legs are those in which the child has been long dead. Here the spine has lost its elasticity or spring. The body will hardly turn, and nothing is to be gained in maintaining the half-breech and pre-

serving the cord from pressure. Turning effected, the process of extraction is carried out in the manner described (see p. 824).

Turning in abdomino-anterior positions does not differ essentially from turning in dorso-anterior positions. It has been shown that the best position for the patient is on her back, and that the right hand may be used. The uterus, as in all cases, is supported externally, whilst the hand is passed along the inner aspect of the child's arm, and behind the symphysis pubis; it proceeds across the child's belly to seize the opposite or further knee. Drawing this down in the direction indicated in Fig. 221, the shoulder rises out of the pelvis.

There is a feature in the history of turning which has not received the attention it deserves. Notwithstanding diligent attention to the rules prescribed, turning is not always complete. The head and part of the chest are apt to stick in the iliac fossa, the trunk being strongly flexed. Complete version, as it theoretically exists in the minds of many who think they are performing the operation, is not often realized in cases where the liquor amnii has long drained off, and the uterus has moulded itself upon the fœtus

FIG. 221.

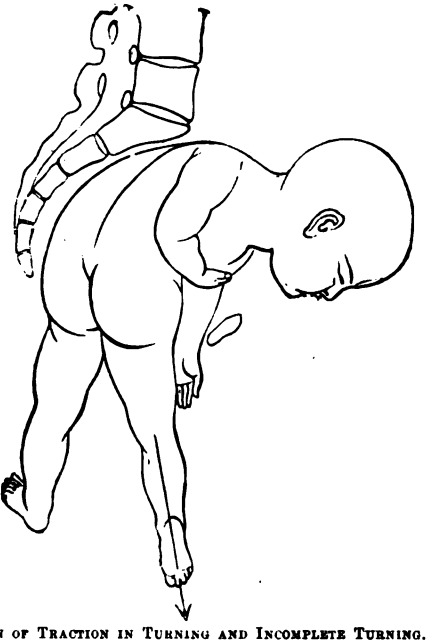
TURNING IN ABDOMINO-ANTERIOR POSITION. DOWNWARD TRACTION UPON THE FURTHER KNEE CAUSES PRESENTING SHOULDER TO RISE OUT OF THE PELVIS. (R. B.)

so as to impede its gliding round. Indeed it can hardly take place unless the bipolar method by combined external and internal manipulation is carefully pursued. The head may commonly be felt throughout the entire process nearly fixed in the iliac fossa, and sometimes the forearm remains fixed in the upper part of the pelvic cavity. The nates and trunk are delivered as much by bending and compression or moulding, as by version. The process is something between version and spontaneous evolution. Fig. 222, taken from graphic memoranda made of a case which occurred to us, serves to illustrate this feature of incomplete turning and the importance of the principle of drawing upon the leg opposite to the presenting shoulder.

If the head and shoulders rise enough to permit the breech to enter the brim, delivery will not be seriously obstructed. But it not uncommonly happens, in extreme cases of impaction of the shoulder in the upper part of the pelvis, that even when we have succeeded in bringing down a leg into the vagina, version will not proceed; the shoulder sticks obstinately in the brim. In such a case the bipolar principle must be called into action. It is obvious that if you draw down upon the leg whilst you push up the

lder you would act at a great advantage; but you cannot get both ls into the pelvis. Sometimes you may release the shoulder by external ipulation, pressing up the head by the palm of the hand, insinuated be-

FIG. 222



DIRECTION OF TRACTION IN TURNING AND INCOMPLETE TURNING. (R. B.)

FIG. 223.

BIPOLAR FORCE APPLIED IN TURNING. (R. B.)

tween it and the brim of the pelvis. In cases of real difficulty, however, this will not answer. You must push up the shoulder by the hand inside. To admit of this you pass a noose of tape round the ankle in the vagina, and draw upon this. The noosing of the foot is not always easy. To effect it you carry a running noose or bow-line knot on the tips of two or three fingers up to the foot, held down as low as possible in the vagina by the other hand. Then the loop is slipped up beyond the ankles and heel and drawn tight (see Fig. 224). Often it is necessary to work with one hand only in the vagina, the hand outside holding on the free ends of the tape ready to tighten the noose as soon as it has got hold; or whilst holding the foot with one hand you may carry the noose over the foot by Braun's instrument or Hyernaux's *porte-lacs*. The foot being securely caught, the right hand is passed into the

FIG. 224.

REPRESENTS THE BIPOLAR METHOD OF LIFTING AN IMPACTED SHOULDER FROM THE BRIM. (R. B.)
The right hand in the vagina pushes up the shoulder, whilst the left hand drawing upon the opposite foot by the tape, version is effected.

vagina, and the fingers, or palm if necessary, are applied to the shoulder or chest. Now, it will be found difficult to draw upon the tape and to push upon the shoulder simultaneously. The most effective manœuvre is to pull and push alternately. Presently you will find the leg will come lower, and the prolapsed arm will rise.

In pushing the chest and shoulder, the object is to get the trunk to roll over on its spinal axis. Here, then, is an indication to execute the manœuvre of Levret and Von Deutsch. *Push the shoulder* and adjacent *part of the chest well forwards*, so as to make them describe a circle round the promontory as a centre. If we could reach and pull upon *the opposite arm*, rotation on the spinal axis might be effected.

Various contrivances in the form of crutches or repellers have been made

as substitutes for the hand in pushing up the shoulder. The objection to them is, that you cannot always know what you are doing. But the hand is a sentient instrument, informing you of what is going on and of what there is to do.

In the majority of cases of this kind we are justified in attempting to turn, because there is still a prospect of the child being preserved. But there are cases in which matters have proceeded a stage further, in which the shoulder and corresponding side of the chest are driven deeply into the pelvis, in which, consequently, there is marked balling of the fœtus. This can hardly occur except after protracted uterine action, such as is scarcely compatible with the life of the child. Either the child was already dead at an early stage of labor—a condition, especially if the child were also of small size, most favorable to the process of spontaneous evolution—or the child has been killed under the long-continued centripetal compression of the uterus.

We have now to study how to deal with the cases, mostly of impaction, beyond the resources of version, in which we have to imitate the process of spontaneous evolution.

The Methods of Delivery in Imitation or in Aid of the Process of Spontaneous Evolution.—The principal of these are: (1) Evisceration; (2) bisection of the trunk; (3) decapitation.

In presence of such cases the question arises: Will Nature complete the task she has begun? Will the child be expelled spontaneously? A little observation will soon enable us to determine how far this desirable solution is probable, and when we ought to interpose. If the pelvis be roomy in proportion to the child, if the child be dead, small, and very flaccid, if we find the side of the chest making progress in descent under the influence of strong expulsive contractions, and if the woman's strength be good, we shall be justified in watching passively. But if we find no advance, or but very slow advance, the child being large and not very plastic, if the uterus have ceased to act expulsively, and the patient's strength be failing, her pulse rising, we must help. In what manner? This must depend upon the circumstances of the case. If a little help *à fronte*, to make up for deficient *vis à tergo*, promise to be enough, we may imitate the proceeding of Peu, who in a case of spontaneous evolution in progress passed a cord round the child's trunk to pull upon.

1. *Evisceration.*—Or we may much facilitate the doubling and expulsion by evisceration. This operation consists in perforating the most bulging part of the chest, and picking out the thoracic and abdominal viscera. When this is done, traction upon the trunk by the crotchet or cranioclast will commonly effect delivery. Sometimes evisceration is insufficient, and further steps are necessary. We may choose between bisection of the trunk or decapitation.

2. *Bisection of the Trunk.*—This is sometimes called *spondylotomy*. It may be likened to breaking a bent stick in the middle, thus destroying the arc, and allowing the pieces into which the stick has been resolved to come through parallel and close to each other. This method is to be preferred when the head is retained above the brim, and access to the neck is rendered difficult by the bulging of the chest and trunk. The spine is to be divided at the most prominent part by strong scissors, by the craniotome, by a knife, or even by getting a strong cord or wire round the body and cutting through the whole body by a sawing movement. Extraction when the trunk is thus broken is generally not difficult. The base of the obstructing wedge is materially reduced, and still greater facility is gained for compression. But it may still become necessary to extract the two parts of the severed

body separately. In this case we should take the lower extremity first, seizing it by the craniotomy forceps. This extracted, the other end to which the head is attached is dealt with in like manner.

3. *Decapitation or bisection at the neck*, sometimes called *decollation*. The recognition, or at least the application, of this proceeding is still so inadequate in this country, that we reproduce the description and illustrations of it given in the "Obstetric Operations." David D. Davis said ("Obstetric Medicine"): "It may be considered a good general rule never to turn when the death of the child is known to have taken place;" and "to decapitate in arm presentations not admitting of the safer performance of turning." Ramsbotham strongly advocated a similar practice. It has also been advocated and practised by l'Asdrubali (1812), Paletta,[1] by Braun, Dubois, Lazzati, and ourselves, amongst others.

The operation may be effected by Ramsbotham's or Braun's hook. D. D. Davis used an instrument of his own contrivance: the guarded embryotomy-knife. A plan sometimes resorted to is to carry a strong cord round the neck, and then by a sawing movement, effected by cross-bars of wood on the ends to serve for handles, to cut through the parts. The cord can be carried round by an instrument like that for plugging the nares for epistaxis, or by Dessaigne's instrument (see Fig. 177). Mattéi has designed scissors for the purpose, resembling the surgical bone-forceps. This is especially useful when it is difficult to pass a hook over the child's neck.

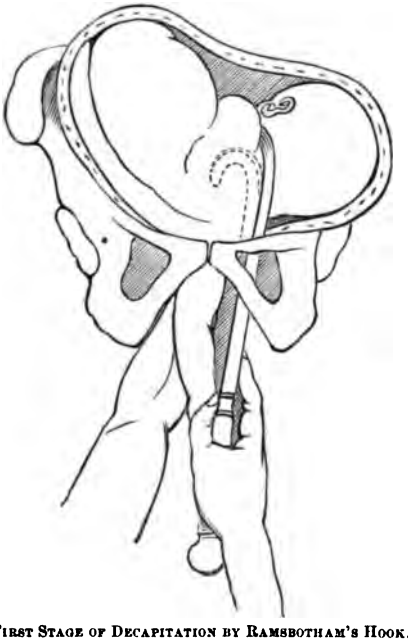
The operation may be described in three stages: (1) The application of the decapitator, and the bisection of the neck; (2) the extraction of the trunk; (3) the extraction of the head.

The First Stage.—The patient may lie on the left side or on the back. Take Ramsbotham's hook or Braun's decollator. As the instrument should be passed up over the back of the child, it is, in the first place, necessary to ascertain whether the position be dorso-anterior or abdomino-anterior. It is also necessary to determine accurately whether the fœtus is still in great part above the brim, lying transversely or obliquely, in which case the head and neck will be in one or other side; or whether a great part of the chest having descended into the pelvis, the movement of rotation has taken place, in which case the head and neck will be found in front, near the symphysis. The next step is to get an assistant to pull down the prolapsed arm, so as to bring down the shoulder and fix it well. This brings the neck nearer within reach. Should the assistant in this duty be in the way, you may seize the prolapsed arm by a clove-hitch of tape, upon which the assistant may pull, keeping clear of the operator. The operator then passes his left hand or two or three fingers into the vagina over the anterior surface of the child's chest until his fingers reach the forepart of the neck. With his right hand he then insinuates the hook, lying flat, as in the dotted line in Fig. 225, between the wall of the vagina and pelvis and the child's back, until the beak has advanced far enough to be turned over the neck. The beak will be received, guided, and adjusted by the fingers of the left hand. The instrument being *in situ*, whilst cutting or crushing through the neck, it is still desirable to keep up traction on the prolapsed arm. In using Ramsbotham's hook, a sawing movement must be executed, carefully regulating action by aid of the fingers applied to the beak. If Braun's decollator be used, the movement employed is rotatory, and at the same time tractile. The instrument crushes or breaks through the vertebræ. Ramsbotham's cuts and saws through. When the vertebræ are severed, some shreds of soft parts may remain. These may be divided by scissors or left to be torn in the second stage of the operation.

[1] Del parto per il braccio, 1808.

The Second Stage: Extraction of the Trunk.—The wedge, widening above the brim, that hitherto obstructed delivery, is now bisected, divided into two lesser masses, each of which separately can readily be brought through the pelvis. By continuing to pull upon the prolapsed arm, the trunk will easily come through, the head being pushed on one side out of the way by the advancing body (Fig. 226). In cases where there was difficulty in extracting the trunk, D. D. Davis used a double-guarded crotchet, the two blades of which, fixing in the trunk, extracted like a forceps. We have never felt any difficulty in simple traction on the arm.

FIG. 225.



SHOWING FIRST STAGE OF DECAPITATION BY RAMSBOTHAM'S HOOK. (R. B.)

The Third Stage: Extraction of the Head.—The problem, how to get a detruncated head, left behind in the uterus, is not always easy of solution. In the case before us, the child having probably been dead many hours, the bones and other structures have lost all resiliency, the connections of the bones are broken down by decomposition, and the whole becomes a plastic mass, easily compressible. Such a head will sometimes be expelled spontaneously, especially if aided a little by expression. We have taken away such a head by seizing it with the fingers. On the other hand, we have several times been called in to extract a head which had foiled ordinary means.

There are four methods of extraction: (1) By the crotchet; (2) by the forceps; (3) by the craniotomy-forceps; (4) by the cephalotribe.

1. *The Crotchet.*—If the crotchet or blunt hook can be passed into an orbit or the cranial cavity, getting a good hold, this may answer. The objection to it is the difficulty of getting a good hold, and the risk of the point slipping, and rending the mother's soft parts. The head, being loose, rolls over when an attempt is made to seize it. It is a plan to be pursued when the better means are not available.

2. *The forceps* is better adapted. If the head can be seized, which is not always easy, for it is apt to escape high above the brim, and to roll about when touched by the blades, extraction is not difficult unless the pelvis is contracted. Care must, moreover, be taken to seize the head in such a way that the spicula resulting from the severance of the vertebræ shall not drag along or injure the mother's soft parts. The seizure is greatly aided by depressing and fixing the head by pressure by an assistant externally.

3. *The craniotomy forceps* is more certain and safe. It is necessary, or at least better, first to perforate. The free rolling of the head, when pressed by the point of the perforator, tends to throw this off at a tangent, missing the cranium and endangering the mother's soft parts. To obviate this, an assistant firmly fixes the head down upon the pelvic brim by both hands spread out upon the uterus. The operator then, feeling for the occiput with two fingers of his left hand, and guided by them, carries up the perforator

Fig. [illegible]

[illegible]

with his right hand, taking care that the point shall strike the head as nearly perpendicularly as possible. He then, partly by a drilling, screwing, boring motion, as little as possible by pushing, perforates the cranium. Thus the risk of the head rolling over and of the instrument slipping, is much lessened. When a sufficient opening is made into the cranium, the craniotomy forceps is applied, the blade inside, the other outside. The blades are adjusted and locked, and traction made in the axis of the pelvis. The head commonly comes without difficulty. During extraction the fingers of the left hand keep upon the skull at the point of grasp by the instrument, guarding the soft parts from injury by spicula, and regulating the force and direction of traction.

[illegible]—This is the best method of all. It is applicable in cases that baffle other means. After perforation, the head, pressed firmly down upon the brim, is readily grasped, crushed down, and extracted. This

method is preferable, we think, in all cases; but it is eminently so when the pelvis is contracted.

There is still another resource, less scientific than the preceding, but one which might under certain conditions, as the want of proper instruments, be employed. It is to amputate the arms at the shoulders, so as to get more room to get at the feet and turn. But as a rule it is bad practice to amputate the arms.

Some other indications than transverse presentation for bipolar turning. Turning is an alternative or elective operation in:

1. Some cases of malposition of the head or face.
2. Prolapsus of cord, when the cord cannot be replaced, competing with the forceps.
3. Descent of a hand by the side of the head, also competing with the forceps.
4. In some plural births to deliver the second child especially.
5. After craniotomy, turning is sometimes a ready way of delivering.
6. After the death of the mother to rescue the child, where Cæsarean section cannot be performed.
7. Generally, when the mother is in proximate danger, from which speedy delivery may rescue her. The principal conditions of this order are: (*a*) Some cases of placenta prævia and accidental hemorrhage. (*b*) Some cases of urinæmic convulsions. In these chloroform or nitrite of amyl, dilatation of the cervix, and bipolar turning offer the best means of safety.

The question in the above relations has been discussed in the sections dealing with the complications set forth.

8. The propriety of *turning in minor degrees of contraction of the pelvis* is a long-contested and still undecided question. To formulate a definite and precise answer which shall guide our action in every case that may come before us is impossible. We may lay down a sliding scale, such as is traced at p. 779, indicating approximately the range of contraction within which a child may be delivered with probability of safety. But we cannot often command accurate knowledge of *both the principal factors* in the problem. For example, we may determine nearly the condition of the pelvis; but we cannot also determine the size and plasticity of the fœtal head, except in some cases of premature labor. The question therefore is likely to remain open for controversy. It will be often solved on what may be called subjective induction—that is, according to the operator's individual capacity, his skill in different modes of delivery, and the quality of the instruments at his command.

We may state at the outset that there are certain cases of deformed pelvis, in which turning is certainly the best both for mother and child. There are certain cases of premature labor, in which the child has not exceeded in size and hardness the capacity of the pelvis. This condition will be discussed in the chapter on the "Induction of Labor."

We may now consider the general question: Is turning ever justifiable as a means of delivery in labor at term obstructed by pelvic deformity? The next alternative in the descending scale of operations is a transition from conservative to sacrificial obstetrics, involving the destruction of the child; that is, if the forceps also fail. The question may be put thus: Do cases of dystocia from pelvic distortion occur in which the child can be delivered alive by turning, the forceps failing, which must otherwise be condemned to the perforator, without injury or danger to the mother? And, assuming that such cases do occur, can they be diagnosed with sufficient accuracy to enable us to restrict the application of turning to them? And if we err by turning in unfitting cases, what is the penalty incurred? How can we retrieve our error?

The extracting of a child through a contracted brim was often performed as a matter of assumed necessity, as, for example, when the shoulder presented. The observation of such cases, a certain proportion of which terminated successfully for the child, could not fail to suggest the deliberate resort to the operation in cases of similar contraction where the head presented.

Again, before the forceps was known, and before other instruments to effect embryulcia had been brought to any degree of perfection, turning was the chief resort in almost all cases of difficult labor. Thus Deventer, who wrote in 1715, as well as La Motte, declaimed against the use of instruments, and recommended turning by the feet in all cases of difficult cranial presentation. Thus the art of turning was cultivated very successfully by some of the followers of Ambrose Paré. But it is not less certain that if children were sometimes saved, many mothers were injured or lost by attempts to turn under circumstances which are now encountered more successfully by the forceps or by craniotomy.

As instruments were improved the choice of means was extended. The forceps first contested the ground. The contest was for exclusive dominion. Chamberlen did not hesitate to accept the challenge of Mauriceau to attempt to deliver a woman with extreme pelvic contraction by his forceps, feeble and imperfect as it was. He failed ignominiously. As science advanced, the contest became better defined. Since the obstruction to delivery was due to contraction of the pelvic brim, and the problem was how to deliver a living child arrested on the brim, it is obvious that a short, single-curved forceps must in most cases fail. It was only when the long double-curved forceps came into use, that the knowledge and the power arose which enabled the obstetric surgeon to bring another means into competition with turning for the credit of saving children from mutilation.

It is, then, from the time of Smellie and Levret, who improved and used the long forceps, that the real interest of the inquiry dates. The following words, written by Smellie in 1752, challenge attention now: "Midwifery is now so much improved that the necessity of destroying the child does not occur so often as formerly; indeed, it never should be done, except when it is impossible to turn or to deliver with the forceps." Pugh, of Chelmsford (1754), relying on the forceps for turning, was able to say, "I have never opened one head for upwards of fourteen years." Perfect (1783) adopted the same practice. La Chapelle (1825) preferred the forceps. She relates that out of fifteen children extracted by forceps (long), on account of contracted pelvis, eight were stillborn, seven alive; and that out of twenty-five delivered footling, sixteen were born alive and nine dead. The percentage is in favor of the forceps. But statistics of this kind require rigorous control.

It is remarkable that it is amongst those who reject the long forceps that the strongest opponents of turning in contracted pelvis are to be found. This is the more astonishing when we reflect that this school—not yet quite extinct—rejecting the two saving operations, has nothing to propose but craniotomy for a vast number of children that claim to be brought within the merciful scope of conservative midwifery.

At the present moment it may be said that the chief advocates of turning are those who do not realize the advantage of a good long forceps, whilst the chief advocates for the forceps are those who do use a good one. Thus it is that Stein (1773), Osiander the elder (1799), Boer, Baudelocque, and more recent authorities prefer the forceps. The late Sir J. Y. Simpson strenuously contended for turning. His forceps has, indeed, a pelvic curve, but it is really short, and quite unequal to do the work of a true long forceps.

We will now discuss the question, What is the penalty incurred, or how can we retrieve our error if we turn and fail to bring the head through the too contracted brim? We may try the forceps to the after-coming head, and, failing that resource, we are driven to perforate after all. We shall have tried to save the child, and failed. Is the mother imperilled by this attempt and failure? This must be answered by experience. Of course, the mother may suffer if we persist in dragging the child too long and too forcibly. But it is right to assume that the attempt is controlled by skill and discretion. The amount of force that can be safely endured is far greater than those who have never seen the operation would readily credit. There appears to be some saving or protective condition. This, we think, is found in the mechanism of the process. In the section on "The Mechanism of Labor in Contracted Pelvis" from projecting promontory, we have shown that promontory forms the centre of rotation around which the head must revolve in order to enter the pelvic cavity. The side of the head applied to this point scarcely moves at all. The promontory catches the fœtal skull in the fronto-temporal region—that is, not in its greatest transverse diameter. If the coarctation be decided, the skull where it is caught bends in. Almost all the onward movement is effected by the opposite or pubic side of the skull sweeping in "Barnes's curve" until the equator or greatest circumference has passed the plane of the brim, when the whole head slips into the cavity with a jerk. Now, injurious pressure is avoided on the pubic side by the smoothness and flatness of the inner surface of the pelvic brim, and by a gliding movement of the soft parts intervening between the head and the bony canal. Injurious pressure on the promontory and its coverings is avoided or lessened by the yielding or moulding of the head. The temporal and parietal bones will bend in, even break. The child has been born alive after this bending and breaking. Sometimes a cephalhæmatoma forms at the point of depression. In other cases the child perishes. These latter cases go to show that the mother may bear with safety an amount of pressure which is sufficient to kill the child.

What follows? This obvious corollary: That the mother may safely bear that lesser degree of pressure which is required to bring through a living child.

The operation, then, is justified in cases of contraction that admit of the passage of a living child. It is further justified in cases of contraction to a certain though small degree of contraction beyond this, which admits of the passage of a dead child. Beyond this, of course, it would be better not to carry the experiment. And if all the factors of the problem could be precisely ascertained beforehand, we should not go beyond this. But whilst calculating upon an average head, we may encounter one above the average in size and hardness, and thus find ourselves in a difficulty. The extrication is by perforation. This is, indeed, an acknowledgment of defeat. It is beating a retreat. The justification is that we accomplish in the end exactly what those who reject the operation accomplish, namely, the safety of the mother. We have at least tried to do more, to save the child as well.

It is not possible to estimate the proportion of children saved by the operation. It would be enough to justify it if we saved a child now and then that could not be saved by the forceps.

An important consideration in favor of turning is that compression of the head in its transverse diameter is much less injurious to the child than compression in its long diameter. Radford, Ramsbotham, and Simpson insist upon this. Now when the forceps is used it is rarely possible to seize the head in its transverse diameter. The contracted flat pelvis throws the head with its long diameter into the transverse diameter of the pelvis, and the blades

of the forceps, finding most room in the sides of the pelvis, will be apt to seize the head in its long diameter. One danger the child runs is from compression of the cord. Now it is a matter of observation that in cases of moderate contraction the funis is safer than in cases of normal pelvis. The cord commonly falls into the side of the pelvis towards which the face looks, and there it is protected in the recess formed by the side of the jutting promontory, so that if the soft parts are dilated so as not to compress the cord against the child's head, and if the labor can be completed under five minutes, or even a little more, the child has a very good chance.

We have stated above some of the arguments upon which the operation rests. The main mechanical argument lies in the following proposition: *The head will come through the pelvis more easily if drawn through base first than by crown first.* Baudelocque affirmed this. The bones overlap more readily if the squeezing force begins below. Osiander, Hohl, and Simpson insist upon this fact. It is disputed by McClintock and E. Martin. Martin especially maintains that, when the vertex presents, moulding may go on safely for hours; but that if the base comes first the moulding must be effected within five minutes to save the child. We have stated some evidence upon this point. A woman with a slightly contracted pelvis, in labor with a normal child presenting by the head, is delivered, after tedious efforts spontaneously and by help of forceps; the head has undergone an extreme amount of moulding, even of distortion. The same woman again is delivered of a child presenting by the breech; the labor has been easy, and the head has preserved more of its globular shape. All this we have seen several times.

Again, we have been called on several occasions to an obstructed labor, in which the head was resting on a contracted brim. We have tried the double-curved forceps under moderate compressive power aided by considerable traction, and have failed to deliver. We have then turned, and the head, coming base first, has been delivered easily.

The Indications for the Operation.—Assuming a standard head, the base of which, unyielding, measures 3 inches, this is obviously the limit beyond which the operation would be useless; for although the head is caught in the bitemporal diameter a little in front of the biparietal diameter, the base must be exposed in its full width to the narrowed strait. Even if the side of the head be indented by the promontory, no important degree of canting or obliquity can be counted upon. But if the head should be undersized or unusually plastic, there is a fair prospect of the child being drawn alive through a conjugate diameter measuring 3 inches. Generally, however, from 3.25 inches to 3.50 inches, or a little more, is the working range for a child at term. The great majority of those who advocate the operation insist upon this amount of space. It is important to have a fair sacro-cotyloid diameter on one side, for if the ileo-pectineal margin of the brim incline rapidly backwards, the occiput will not find room.

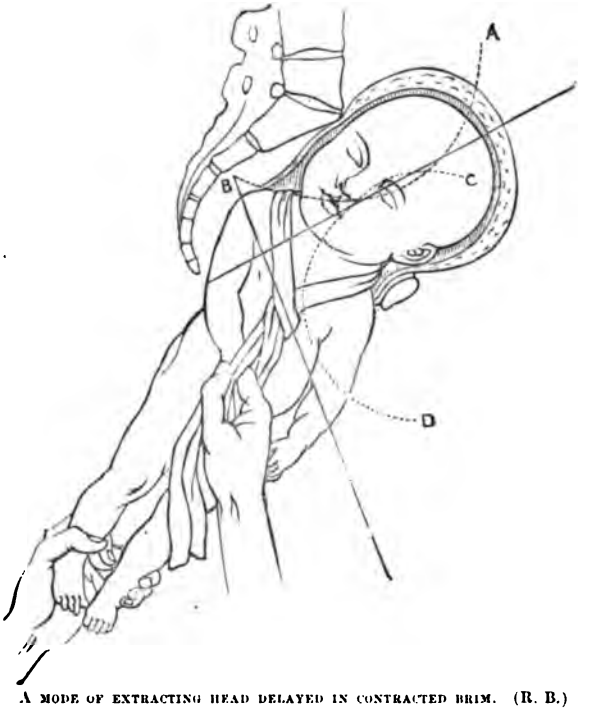
Velpeau, Chailly, E. Martin, and others advise the operation in cases of unequally contracted pelvis where there is more room on one side than on the other, when the occipital end of the head is not already engaged in this larger side. To determine which side of the pelvis is the larger, attention to the following points will help: (1) If the woman walks straight, and the legs are of equal length, the defect in symmetry will be slight, but the presumption is that the right side is the larger; (2) if the woman has one hip affected, or one leg shorter than the other, the opposite side of the pelvis will be the larger; (3) the two half-circumferences of the pelvis externally from the crest of the sacral spine to the symphysis pubis may be measured and compared; (4) the hand in the pelvis may estimate the relative space in the two sides.

The cervix uteri should be dilated enough to admit the fingers pointed in a cone, and dilatable enough to yield readily under the extraction of the trunk. In this, as in most cases where the head cannot press fairly upon the cervix, spontaneous dilatation is tedious. The hydrostatic bags render especial service. The membranes should be intact, or there should be enough liquor amnii present to admit of easy turning.

The contraindications are: (1) A conjugate diameter narrowed to less than 3 inches; (2) firm contraction of the uterus round the child, balling it; (3) impaction or very firm setting of the head in the brim of the pelvis; (4) marked exhaustion or prostration of the mother; (5) death of the child.

The Operation.—As the conditions postulated admit of bipolar action, it is important to avail ourselves of it. If exploration satisfy us that the pelvis is symmetrical, we turn according to the ordinary rules. Extraction should be gentle and slow until the breech is delivered. So long as the cord pulsates

FIG. 227.



A MODE OF EXTRACTING HEAD DELAYED IN CONTRACTED BRIM. (R. B.)

do not hurry; but if the pulsations flag, lose no time in liberating the arms. The pelvic contraction makes this a little more difficult than under ordinary circumstances. As soon as the arms are liberated the real difficulty begins: the extraction of the head. Sometimes the head is delayed by being encircled by the imperfectly dilated os uteri. This is an unfortunate complication, since compression at this point is likely to stop the circulation in the cord. It is above all things necessary to draw at first as much backwards as possible, so as to make the head revolve in Barnes's curve (A B, Fig. 227) until it has cleared the strait, when it enters Carus's orbit, C D. Traction is effected by holding the legs with one hand and the nape of the neck with the other.

Commonly, the force thus obtained, aided by pressure from above upon the fundus, is enough, but sometimes more is wanted. This is obtained by crossing a fine napkin or silk handkerchief over the neck, bringing the two ends in front of the chest and drawing upon them, as in Fig. 227.

When the pelvis is unequally contracted, the object is to throw the big or occipital end of the head into the more roomy side of the pelvis. E. Martin describes three modes of effecting this:

1. *A suitable position of the woman* is secured. Let her lie on that side to which the forehead is directed. The fundus uteri will gradually sink with the pelvic end of the child to this side; the spine draws the occiput to the opposite side of the pelvis, and the forehead sinks more deeply towards the brim.

2. The forceps is a means of releasing the posterior transverse diameter of the head when imprisoned in the pelvic conjugate. This explains the frequent easy extraction when a little traction has been made. Martin admits that we must not be sanguine as to the success of this plan. We must be prepared to perforate if there be evidence of exhaustion.

3. *Turning by the Feet.*—How is this to be done? In consequence of the well-known law, that in complete foot presentation the foot that is brought down always comes under the pubic arch, if the fœtus is not abnormally small or the pelvis too large, if we draw down the right foot, the child's back, and therefore its occiput, will come into the right half of the pelvis, and *vice versâ*. If, therefore, the right half of the pelvis is the larger, seize the right knee; if the left side is larger, seize the left knee.

Hohl and Strassmann doubt the possibility of securing this result. If it happens, it does so by accident. We believe the rule and practice are good and feasible, but the success of the operation is not necessarily imperilled even if the occiput should fall into the narrower half of the pelvis. We have saved children when this has happened, and Strassmann relates some striking cases in proof of this proposition.[1]

If, after all, the forceps and turning fail, we fall back upon craniotomy. There is no great difficulty in perforating the after-coming head. The child's body is drawn well over to one side by an assistant, so as to facilitate the access of the operator's guiding fingers and the perforator to the head. The best place to perforate is in the occiput, but if that part be not easily struck, the perforator may be run up through the base of the skull. An opening into the cranium being made, the crotchet is passed in, and the discharge of brain facilitated. Then resuming traction on the cord cautiously, the skull will probably collapse enough to pass easily. If not, the cranioclast, or the cephalotribe, must be had recourse to. If the forceps or turning have been tried at the proper time, before the patient is exhausted, retrieval by the secondary operation of craniotomy may be confidently expected.

General Appreciation of the Operation.—For some years Robert Barnes, although possessing a far better forceps than Simpson's, accepted the teaching of this great master, and gave the preference to turning. This was advocated in the "Obstetric Operations" (1876). Subsequent experience of his own, and the independent experience of Fancourt Barnes, especially with the axis-traction forceps of Aveling and Tarnier, have compelled him to revise the opinion expressed in that work. We have arrived at the conclusion that generally the forceps is to be preferred; and that in those cases in which the feet have come first, either spontaneously or after turning, still delivery of the after-coming head by the forceps is preferable to dragging the head through by the hands. The forceps should be tried first; and it is

[1] Monatsschr. f. Geburtsk., 1868.

all important to use the axis-traction forceps. Having brought forth living children by this instrument from women who had lost children by turning or with ordinary forceps, we cannot doubt its superiority. The axis-traction forceps, thus extending the domain of the forceps, *pari passu* lessens the domain of turning. This is a crucial test of the value of the axis-traction forceps.

THE DANGERS TO MOTHER FROM TURNING.—These may be summed up thus: (1) In cases free from disproportion, in which bipolar turning can be effected without difficulty, the danger is small. (2) The danger rises when liquor amnii has escaped, and persistent action of the uterus has set in. Exhaustion, rupture of the uterus, sloughing of the vagina, injury to the bladder, may be apprehended. (3) The danger rises still higher if, in addition, there be marked contraction of the pelvis, or the head be large and not plastic. In these cases force in passing the head may rupture the uterus or vagina.

DANGERS TO THE CHILD.—The dangers to be apprehended are: (1) Asphyxia from compression of the cord; (2) from dragging in extraction before the cervix is dilated; (3) from dragging in a vicious direction, entailing dragging on the neck, the cervical articulations may give way; (4) from rotating the child on its long axis the neck may be twisted; (5) from compression and laceration of the brain or its vessels during extraction; (6) from direct pressure upon the placenta between the child's head and the uterus asphyxia may result. The same result may happen from unintermittent uterine contraction arresting the utero-placental circulation.

We do not attempt numerical estimates of mortality, for reasons similar to those stated in reference to statistics of mortality from forceps. The sources of fallacy are too great to justify the attempt.

CHAPTER XXVIII.

EMBRYOTOMY: INDICATIONS FOR; PELVIC DISTORTION; DISPROPORTION BETWEEN HEAD AND PELVIS; THE OPERATIONS; CRANIOTOMY; CEPHALOTRIPSY; LAMINATION OF HEAD. DANGERS ATTENDING EMBRYOTOMY.

RELUCTANTLY passing from the conservative operations of the forceps and version, we turn perforce to the sacrificial operations of embryotomy, in obedience to the peremptory law which enjoins us to sacrifice, if need be, the child in order to save the mother. Coming after the forceps and turning, craniotomy stands before the Cæsarean section—an operation which, although conservative in design, is so dangerous to the mother that it is held better to avoid it by sacrificing the child.

The motive of the operation is to save the mother by reducing the child's bulk to such dimensions and other conditions that it may be delivered with the least possible injury to the mother. One form of embryotomy has been described in the chapter on "Version," namely, spondylotomy and decapitation. The form which specially demands attention now consists essentially in reducing the bulk of the cranium, this part presenting. Hence the term *craniotomy*.

ANALYSIS OF THE OPERATION.—Craniotomy consists of several successive operations or acts, as: 1. Perforation of the skull. 2. Excerebration. 3. Extraction, simple: (*a*) by crotchet; (*b*) by cranioclast, or extraction after crushing down the cranium by removing portions of the cranial vault by the cranioclast, by the cephalotribe; (*c*) by lamination; (*d*) by breaking up the base of the cranium by the basilyst.

THE INDICATIONS FOR THE OPERATION.—These may be classed in three orders:

A. Dystocia from such contraction of the pelvis as will not give passage to a live child, or even a dead child, when the forceps and turning are excluded or have failed.

B. Cases where obstruction is due to the child.

C. Cases where the woman is in danger, rendering it expedient to deliver as speedily as possible, and where craniotomy offers the quickest relief and involves the least violence to the woman. Some cases of hemorrhage, of convulsions, great exhaustion, rupture of the uterus, and generally where, prompt delivery being indicated, the cervix uteri is not sufficiently dilated or dilatable, or extreme spastic rigidity not admitting of conservative operations. In cases of atresia, cicatricial, or from malignant diseases of the cervix or vagina; also in cases of dystocia, the child being dead. Under this order may also be classed obstruction from tumors (see p. 748). B and C have been pointed out in the opening section on "Dystocia" (see p. 775).

A. *Dystocia from Pelvic Distortion.*—Craniotomy finds its application where labor at term is obstructed from pelvic contraction, the conjugate diameter ranging from 3.25 or 3.50 inches as a maximum, to 1.75 or 1.50 as a minimum. If labor occur at seven months, the operation may be available in contraction to 1.50 inches or a little less. F. Ramsbotham held that a full-grown child might be extracted through a pelvis measuring 3 inches in the lateral, and two inches, or even 1.75 inches, in the conjugate diameter.

And since his time the instruments and methods of reducing the child, and of extracting it, have been materially improved.

Still it is very difficult to set exact limits to the operation on the sole basis of pelvic distortion. We may determine this factor with some approach to precision; the other factor, the properties of the fœtus, and, we may add, the skill of the operator, cannot be determined. Nor can the history of a given patient's previous labors, valuable as this often is, be always trusted. It would not be right to assume that because a woman has been delivered on previous occasions by the natural powers, by forceps, or by turning, it is therefore unnecessary to resort to craniotomy. It is, indeed, a strong reason to pause and examine carefully. It is a matter of experience that some women bear children with increasing difficulty. This may be from two causes: (1) Advancing pelvic distortion; (2) increasing size of the child. We can affirm the reality of the first cause from repeated observations. We have histories of women whose first labors have been natural, and whose succeeding labors exhibited difficulties increasing in accelerated ratio, rising from the forceps to turning and craniotomy. The second cause may be independent of or aggravate the first. The observation of D'Outrepont, that in women whose first children were small, subsequent ones became bigger and bigger, has been verified by recent researches.

B. *Hydrocephalus* is a rare but decided indication. The condition may be recognized by the slow, ineffective labor; the expansion of the head-globe, only a segment of it entering the pelvic brim; the bulging of the scalp like a bag of membranes under the uterine contractions; the widely separated bones by broad membranes; the loose bones. After perforation the scalp feels "like a bag of bones."

C. Cases where indications arise from the state of the mother need no particular description here.

The Operation.—An important question is, At what stage of the labor shall we begin? As most of the dangers flow from exhaustion, it is obviously proper to begin as soon as the indication for the operation is clear and the conditions admit of its being fairly carried out. On the Continent, especially, it is still urged by some that we should wait until the child is dead. If it be admitted, and the conditions of the case involve these postulates: (1) that the child cannot come through alive, (2) that the operation is undertaken in order to save the mother, waiting till the child is dead is opposed alike to reason and to humanity. It seems a refinement of casuistry to distinguish between directly destroying a child, and leaving it exposed to circumstances which must inevitably destroy it; and it is risking the very object of our art to wait for the lingering death of the child until the mother's life is also imperilled.

There is no need to wait for the far advance of labor. It is rarely desirable to wait long after the rupture of the membranes. It would, in many cases, be useless to wait until the full dilatation of the cervix uteri. It is one of the necessary results of contracted brim that the cervix uteri dilates slowly and imperfectly. The head-globe, resting by two points of contact on the contracted brim, cannot bear upon the cervix. It is, therefore, often right to perforate when the cervix is open enough to admit two or three fingers. When the head collapses and comes down into the pelvis it bears upon the cervix, which then gradually yields.

Although it is a good general rule to perform every operation as early as the indication for it is clearly recognized, it is not expedient, in minor degrees of contraction, to arrive too quickly at the conclusion that perforation is necessary. Time and opportunity should be given to Nature. The head may be small and plastic, and occasionally even a full-sized head will, under

continued action of the uterus, become so moulded as to admit of delivery either spontaneously or by aid of the forceps.

The Operation: Preliminary Proceedings—Empty the bladder and rectum; place the patient in the left lateral or in dorsal posture. Anæsthesia is rarely desirable before the stages of fixing the cephalotribe and extraction begin.

First Act: Perforation.—This is the first step in all operations for lessening the bulk of the head. The necessary condition for full collapse of the cranial bones is that the support given by the brain and the integrity of the cranial vault should be broken down. The skull, unbroken, and full, is all but incompressible. By great expenditure of force and time some amount of moulding, but no diminution of bulk, can be obtained. Powerful forceps and even cephalotribes may be bent in the attempt to crush in the head; whereas, break the arch of the cranial vault, allow the contents to escape, and a very moderate compression by instruments, and even the natural forces, will cause collapse, more or less complete. Besides, more room is required if we apply the cephalotribe to the unbroken head. This argument is rendered necessary by the fact that some obstetrists still practise cephalotripsy without perforation.

A final exploration should precede perforation. The left hand of the operator should be passed into the pelvis, under anæsthesia if necessary, so as to explore thoroughly the shape and dimensions of the pelvis and the relations of the head and cervix uteri. Three points should be clearly made out: (1) The projection of the promontory, which in extreme cases has been mistaken for the head; (2) the outline and position of the head; (3) the os uteri should be well defined. The finger passed inside the cervix should be made to sweep all round the circumference of the head. Thus we shall define precisely the point to strike with the perforator.

The point selected is that which presents most centrally. An assistant should support and fix the head upon the pelvic brim, so as to obviate the retreat or rolling of the head under the impact of the perforator. It is also necessary to take care that the instrument strike the skull perpendicularly. Sometimes, in cases of great deformity, the uterus is so twisted from its normal direction that reposition is necessary before the os can be brought near the centre of the brim to allow of safe perforation.

Taking Oldham's perforator in the right hand, two fingers of the left hand are passed up to the head, keeping the os uteri at their back; the instrument is then run up in the groove formed by the fingers. The point having struck the spot selected, the perforation is effected by a movement combining boring and pushing. When the skull is pierced, push the blades in up to the shoulders; then open the blades to enlarge the aperture, turn the handles at right angles to the first position, and open the blades again, so as to make a free crucial opening. This breaks the continuity of the cranial arch; it allows free discharge of the cranial contents, and ample entry for the crotchet or blade of the cranioclast.

Now you may wait awhile, to afford opportunity for spontaneous compression and collapse, or you may at once pass in the crotchet. This should be passed in as deeply as possible and moved freely round in all directions, to break up the tentoria and brain. This proceeding greatly facilitates the evacuation and collapse of the skull. This is *excerebration*.

If the disproportion is not great, and the patient's powers are good, it commonly happens that uterine action sets in as soon as the bulk of the head is a little diminished. The resulting compression and propulsion may suffice to expel the child. It seems as if Nature resumes work as soon as she realizes the fact that it can be done efficiently. Reasonable opportunity should be given for the spontaneous process.

Should no advance be made, the case falls into the second order, and we must proceed to artificial compression of the skull, and next to extraction.

Second Act.—Extraction may be accomplished in several ways: (1) By the *crotchet.* The proper use to which the crotchet should be applied is that just described in excerebration. It was long used in this country for extraction; but it has, we trust, been generally abandoned for the cranioclast and the cephalotribe. The objections to the crotchet are serious: It gives a very weak hold of the skull; it is apt to tear off a bit of bone or scalp, and the hold is lost; it is apt in slipping to tear the mother's soft parts; and, lastly, it is only capable of extracting the head in those minor cases of disproportion, in some of which it might be doubted whether craniotomy was necessary. But since a good cranioclast or cephalotribe may not be at hand, the mode of using the crotchet must be described. The fingers of the left hand guide the end of the crotchet into the hole in the skull. Two fingers are then passed up outside the skull to serve as a guard and support to the sharp point of the crotchet, which is fixed into the bone inside. The part first seized by the crotchet is not, perhaps, very important, since if there be any great resistance the part will be broken away, and a fresh hold must be made. This may have to be repeated several times, pieces of the parietal, occipital, or frontal bones being successively torn out. Whenever a piece of bone is detached, it is wise to remove it altogether. This may generally be done with the fingers. By and by—for the process is apt to be tedious—when the cranial vault is much broken up, if a good hold can be got in the occipital bone or in the foramen magnum, collapse of the skull takes place, and extraction is successful. In very difficult cases, when the vault is well broken up, it is better to take hold in the orbital region, fixing the point of the crotchet either inside the skull under the sphenoid on one side of the sella turcica or in the eyeball. In this way the base is brought into the brim edgewise.

2. *Extraction by Turning.*—When the cranial vault is broken the bones will readily collapse if the skull be drawn through the contracted brim base first. The torn scalp during extraction is drawn over the jagged edges of the bones. The child, being dead, does not always lend itself readily to turning. It may be necessary to pass the hand into the uterus, which is moulded on the child, and through a brim so contracted as to oppose considerable difficulty. Turning, however, must be regarded as a valuable resource in emergency.

3. *Extraction by Cranioclast.*—This is generally preferable to turning. The use of this instrument is twofold: it will seize and extract the head; it will seize and remove portions of the cranial vault. The first use is adapted to minor degrees of disproportion; the two uses combined may effect delivery in extreme disproportion. What part of the vault is best to seize? If the head is found to collapse, and the disproportion is not great, it is enough to seize the forehead, which, being generally directed to the right ilium, is the easiest to seize. But if there is any great difficulty, it is generally better to quit the forehead and seize by the occiput. The head will not come down well, face presenting, unless the vault and occiput are in a condition to be crushed in against the base. In this proceeding, compression of the skull is effected by its being drawn through the narrow passage formed by the soft parts supported by the pelvis. The head must, therefore, be ductile enough to admit of the necessary compression and elongation. If the skull be too unyielding or the passages too small for this process, a totally different principle must guide us. Portions of the vault must be removed, and then we get the most remarkable advantage.

Osborn contended that by canting the base of the skull, so as to bring it

edgewise into the brim, it was quite possible to deliver a full-sized child through a conjugate diameter measuring an inch and a half only (Fig. 228). Burns came to the same conclusion, and showed that by reducing the skull to its base, and bringing it through as in face presentation, nothing was opposed to the conjugate but the distance from chin to orbital plates, which is rarely much more than an inch. This subject has been investigated by Braxton Hicks.[1] Having removed the calvarium, he grapples the orbit with a small blunt hook; the hook is hard, the stem soft, so as to admit of easier adaptation. The face is then drawn gently down, turning the chin forwards, as occurs in face-labors. A fresh hold in the mouth or under the jaw is then taken for traction.

4. *The Author's Method.*—We prefer the cranioclast. The proceeding we practise is as follows: Pass the inner or small blade into the cavity of the

FIG. 228.

EXTRACTION BY BARNES'S CRANIOCLAST, AFTER PICKING OFF VAULT OF CRANIUM. (R. B.)
A. Projecting promontory of sacrum. C. Tip of coccyx.

skull; then the outer blade is adjusted between the portion of bone to be removed and the scalp. Then a considerable piece of parietal or occipital bone being seized, by a sudden wrench is broken, and then cautiously twisted off and brought away under the guidance of the left hand or fingers in the vagina. If the distortion is not extreme, it may be enough to break away two or three pieces, say an angle of each parietal and of the occipital. This destroys the arch of the calvarium; the remains of the walls then easily fall in upon the base, forming a flat cake or disk, when the head comes to be compressed in the chink of the brim. When enough bone has been taken away to admit of this flattening in, the blades of the cranioclast are made to seize

[1] Obst. Trans., 1865.

the forehead and face, the screw working at the ends of the handles helping to crush in the frontal bones, and to secure an unyielding hold. The cranioclast, in fact, here acts like the cephalotribe, possessing the advantage of taking up less room. Then traction is made first in Barnes's curve. As the face descends it tends to turn chin forwards, and this may be promoted by turning the handles of the instrument. It is not necessary that this turn should take place, for the case differs entirely from that of the normal head. There is no occiput to roll back between the shoulders. The head comes through flat like a disk.

If the pelvic contraction be very decided—say 2.5 or 2 inches or under—it will be wise to take away the greater part of the frontal, parietal, squamous, and occipital bones before extraction. By this proceeding delivery can be effected in all but the very extreme degrees of contraction. We are

FIG. 229.

EXTRACTION BY BARNES'S CRANIOCLAST, AFTER REMOVING BONES OF CRANIAL VAULT. SEEN IN SECTION. (R. B.)

convinced that it competes successfully with cephalotripsy for the credit of averting Cæsarean section.

5. *Delivery by Cephalotripsy.*—The cephalotribe takes more room than the cranioclast, and, therefore, in some cases the cranioclast or the basilyst is to be preferred. Nevertheless, cephalotripsy possesses considerable special advantages, and may lend much help to other proceedings.

The Powers of the Cephalotribe.—The essential point is that it shall be able to compress and crush down the remains of the calvarium upon the base of the skull, so as to bring the flattened skull to the condition of a disk that shall pass through the pelvic chink. A secondary property is that of holding during extraction. The cephalotribe, then, is a reducing and an extracting instrument. Most of the French and German models are unnecessarily bulky. The requisite force can be obtained with less size and weight of metal. Having

worked with Simpson's, Kidd's, and Braxton Hicks's instruments, we have recognized the importance of a slight pelvic curve which Hicks's possesses; but we find the blades too short to seize the head above the brim. All the difficulties seem overcome in Fancourt Barnes's cephalotribe (see "Armamentarium," Fig. 175). It has a slight pelvic curve, sufficiently long and powerful blades, and the special advantage of the perineal or Aveling's curve. The advantage this gives in traction can hardly be appreciated except by those who have had comparative experience. The facility gained by axis-traction is very marked, and by so much is the risk of bruising the mother's structures lessened.

The action of the cephalotribe, applied to the perforated head, is partly to crush the base, imparting greater plasticity; then the base is tilted edgewise, and the skull is flattened down by squeezing the squamous and parietal bones on to the base (see Fig. 230).

FIG. 230.

FANCOURT BARNES'S AXIS-TRACTION CEPHALOTRIBE, APPLIED.

It is sometimes held, and still taught, that the cephalotribe acts by crushing up the base of the skull—that is, by breaking into pieces the solid disk formed by the sphenoid, temporals, and basilar process of the occipital bone. This is an error. The moment the disk is seized by the blades of the cephalotribe, it tends to cant over and lie flat between the blades, the loose bones of the calvarium being crushed down upon it. Seizure and compression of the base so accurately as to secure crushing it up is almost a mechanical impossibility. The slightest inequality of seizure on the two edges, the slightest inequality of force, will necessarily entail canting. It is to obviate this and insure crushing the base that the basilysts are contrived. For this purpose Goyon and A. R. Simpson begin by perforating the base.

Ingenious and effective as these proceedings undoubtedly are, we cannot regard them as superior in safety or effectiveness to the process of cephalotripsy as we have described it. By this process, the head can commonly be so flattened as to allow the blades almost to meet; and as the instrument

then measures only 1.5 inches, the obstacle is reduced to that degree. It is generally desirable to repeat the crushing, which is done by taking a fresh hold in a different direction, and then compressing again. This increases ductility.

The Operation.—The patient may lie on the left side or on the back. The head is perforated as already directed. The rules laid down for the long forceps will generally apply to the adjustment of the blades of the cephalotribe. The lower or posterior is passed first, guided by the left hand, passed well into the pelvis if possible. This blade is passed along the hollow of the sacrum until the point approaches the brim and touches the head-globe; then the handle is raised, and the point, turning into the left ilium or to the left sacro-iliac joint, travels over the head. It is passed high up, for the point of the instrument must get beyond the base of the skull. This blade being *in situ*, the second or anterior blade is introduced also at first in the sacral hollow, crossing in front of the first blade. When the point approaches the brim, the handle is lowered and carried backwards, and the point rises over the head-globe into the right ilium, or opposite the right cotyloid cavity, when it falls into apposition with the first blade. Being locked, the screw is turned slowly and steadily, the hand in the vagina taking note of the work done. If spicula of bone crop up out of the scalp, they should be picked away by the fingers or the cranioclast. When the head is crushed in the direction first seized, the instrument may be used as a tractor. If there be any marked resistance, it is better to take off the blades, to reapply them in the opposite direction, and repeat the crushing. This much increases ductility. Then rotate the head by turning the handles about a quarter of a circle, to bring the flattened head into rotation with the transverse diameter of the brim before extracting, so as to bring the head, flattened like a disk, to enter the chink of the inlet of the pelvis. It is not, indeed, always necessary to give this rotation. The necessary adaptation may take place spontaneously. Extraction in the direction of the pelvic axis is thus made, taking care to allow time for moulding and for the dilatation of the cervix uteri, vagina, and vulva.

When the head is extracted, there may be some trouble with the shoulders and trunk. The shoulders will generally be disposed obliquely in the brim —that is, one will be anterior to the other. By keeping up axis-traction on the head backwards, the anterior shoulder will be brought a little down, so that a finger or a blunt hook or crotchet can be fixed in the axilla to pull it through. When this is done, the head is dragged down forwards, so as to enable the same manœuvre to be repeated with the posterior arm. If this cannot be readily done, it is a good plan to crush in the chest with the cephalotribe. In extreme cases it is sometimes useful to use both cephalotribe and cranioclast. For example, the cephalotribe having crushed and seized the presenting part, and served to draw it down to a certain extent, the instrument may slip a little, or the fœtus may show signs of giving way above the point gripped. The craniotomy forceps may then be made to take a fresh hold at a higher point.

If turning has been practised after craniotomy or cephalotripsy, the arms fall in upon the crushed head, and offer no serious obstruction.

To avoid the ghastly sight of the mangled head, a napkin should be wrapped round it as soon as it is born.

In this country, when good instruments for embryulcia were unknown, it was the practice to leave the head after perforation to be gradually moulded and expelled. Pajot[1] advocates an analogous proceeding, which he describes

[1] Preface to the French edition of Robert Barnes's "Obstetric Operations."

as "céphalotripsie répétée sans tractions." He first crushes in the base by one operation, and he then gently tries to effect a slight rotation of the instrument, so as to bring the crushed sides of the head into relation with the contracted inlet. If there is any resistance he desists, and leaves the case for two or three hours for the uterus to mould the crushed head to the brim. He then repeats the crushing, and again gives two or three hours to Nature. One or two crushings suffice for the trunk. Chiara gives a good case in illustration. Pajot places this method in distinct competition with Cæsarean section. His cases lend weight to his recommendation. But we cannot help thinking that the operation may and generally ought to be completed at one sitting. The head expands again to a considerable degree when the cephalotribe is taken off. And waiting upon Nature may be to invoke exhaustion.

Delivery by Lamination.—To overcome the obstacles opposed by the unyielding base of the skull and the bulk of the cephalotribe, various other modes of reducing the skull have been devised. The general aim of these is to cut the skull in slices or pieces. Hence the term "lamination." One of the first of these contrivances is *Van Huevel's forceps-saw.* It was introduced in 1842. It is a distinctive feature of the Belgian school. Hyernaux rejects in its favor all crotchets and cephalotribes. The instrument has also found favor with Faye, of Christiania, and Billi, in Italy. It consists of long powerful forceps with the pelvic curve, the blades of which are grooved along the inner aspect in order to carry a chain-saw. When the head or other part of the child is seized by the forceps, this chain-saw is worked up from the point whence the blades spring by means of cross-handles attached to the two ends; thus travelling up the grooves, the saw crosses the head and cuts through it. For extraction Van Huevel contrived a pair of forceps toothed on one blade.

The objection to this instrument is its bulk. This renders it difficult or impossible to apply when the conjugate is reduced to 2 inches, or even to 2.5 inches. The blades must be got to lock accurately in order to work the saw. Obstruction to these degrees can be more easily overcome by perforation and the cephalotribe or cranioclast.

Delivery by Robert Barnes's Method by the Wire-écraseur (1869).—The difficulty of finding room for the cephalotribe in extreme distortion led the senior author to adapt the wire-écraseur to lamination. Nothing can take up less space than a wire. It is desirable, but not necessary, first to perforate. It further facilitates the operation to twist off a portion of the parietal bones by the cranioclast. The wire-loop thus buries itself more readily in the skull, a smaller loop is required, and it cuts its way through the base more readily. If the sphericity of the globe is not first destroyed, the wire-loop is apt to glide off the head, seizing only the scalp when the screw is worked. The crotchet is next passed into the hole made by the perforator, and held by an assistant so as to steady the head (see Fig. 231). A loop of strong steel wire is then formed, large enough to encircle the head. The elasticity of the wire permits of the loop being compressed by the fingers, so as to make it narrow enough to slip through the cervix and the chink of the pelvic brim. The loop is thus guided over the crotchet to the right side of the uterus, where the face lies. The compression being removed, the loop springs open to form its original ring; this is guided over the anterior part of the head as in Fig. 231, B. The screw is then tightened; instantly the wire is buried in the scalp. Here is manifested a special advantage of the operation, the whole force of the necessary manœuvres is expended upon the fœtus. There is no outward pressure upon the mother's parts, which to some extent is inevitable with the cephalotribe or Van Huevel's forceps-saw. When the anterior or posterior segment of the head

is seized in the wire-loop, a steady working of the screw cuts through the head in a few minutes. The loose segment is then removed by the cranioclast.

In minor degrees of contraction, the removal of one segment is enough to enable the rest of the head to be extracted by the cranioclast. But in cases of extreme distortion it is desirable still further to reduce the head by taking off another section. This is best done by reapplying the loop over the occipital and end of the head, as seen in Fig. 231, A. It thus accomplishes what the cephalotribe does not; it breaks up the base of the skull.

FIG. 231.

SHOWING ROBERT BARNES'S OPERATION OF LAMINATION BY THE ECRASEUR.

The small part of the skull still remaining attached to the trunk offers no obstacle. It serves as a hold for traction. The cranioclast seizes it firmly, and the delivery of the trunk is proceeded with. If the child be well developed, this task will require considerable skill and patience. An assistant draws steadily on the cranioclast, directing traction to one side so as to bring a shoulder into the brim. The operator then hooks the crotchet into the axilla, draws it down, and with strong scissors amputates the arm at the shoulder. This proceeding is then repeated on the other arm. Room is

then gained to deal with the thorax. This is then perforated. One blade of a strong scissors is passed into the aperture; the ribs are then cut through in two directions. Then the thorax and abdomen are eviscerated by the crotchet, until the trunk is in a condition to collapse completely. This done, moderate traction will complete delivery.

We have designed a proceeding by which the arms can be amputated even more easily. A curved tube, shaped like Ramsbotham's hook, may be made to carry a strong wire under the axilla; and the end being brought out and the tube removed, the wire can be attached to the écraseur. This cuts through the limb with ease and security. Decapitation may be conveniently performed in the same way. Wasseige's crotchet is made on this principle to carry a cord. Pajot decapitates by a whipcord. *Tarnier's method* is carried out by an apparatus similar in principle to Van Huevel's, but much lighter and taking up less room. It consists of two branches or stems, one of which is curved to correspond with the sacral curve, the other is nearly straight. These branches carry a travelling chain-saw, which, like Van Huevel's, works from below upwards, so that the division of the skull begins below. Having cut through to the base, one can begin again, and so take out a wedge-shaped slice or section.

Numerous other instruments have been designed. We may note those of Jacquemier, Wasseige, Van der Ecken, Stanesco, Pierre Thomas. They are figured and described in Charpentier.[1]

THE DANGERS AND MORTALITY ATTENDING EMBRYOTOMY.—Certain injuries may be inflicted upon the mother: 1. The perforator has been known to lacerate the soft parts, and even to strike the promontory of the sacrum. 2. Spicula of cranial bones may scratch or tear the soft parts. 3. The crotchet may slip and lacerate the soft parts. These accidents may be avoided. 4. The cephalotribe may bruise the soft parts. The risk of this may be greatly lessened by using the axis-traction instrument. 5. But serious evil is likely to result from deferring the operation too long—that is, until exhaustion has set in, and under a too-protracted operation in an unsuitable case. Long-continued dragging of the head upon a brim which it cannot pass, jamming the soft parts, especially at the two points of greatest projection, the promontory and the symphysis pubis, ends by stopping the circulation in the parts compressed, bruising them, actually grinding through them. Such injury, added to the shock and exhaustion, may be fatal. The soft parts at the vulva and perineum, greatly deprived of vitality, lose elasticity. They become livid or black from congestion, and break down or tear like wet brown paper. When the tissues have arrived at this point recovery is doubtful, and, if attained, sloughing, more or less extensive, ensues. It is a form of acute necrosis. 6. Long-continued pressure may cause mortification of a limited portion of the neck of the uterus. In the course of a few days a slough may be formed between the vagina and bladder, leading to vesico-vaginal fistula.

It is impossible to determine the maternal mortality resulting from embryotomy. The causes of death are complex. The injuries attending the labor itself, the shock and exhaustion due to protracted unavailing labor, and the injuries done during the operations, are often inextricably mingled. The danger of injury of course rises with the degree of distortion, the imperfection of the instruments, and the lack of skill of the operator. Thus we at last arrive at a point where the danger of embryotomy becomes so great as to raise the question whether the Cæsarean section is not safer, and therefore to be selected.

[1] Traité Pratique des Accouchements, tome ii., 1883.

CHAPTER XXIX.

THE CÆSAREAN SECTION: GENERAL DISCUSSION; MORTALITY. INDICATIONS FOR: EXTREME PELVIC CONTRACTION, TUMORS, MALIGNANT DISEASE, WHEN MOTHER IS MORIBUND. THE OPERATIONS: SIMPLE, PORRO'S, LAPARO-ELYTROTOMY, CÆSAREAN SECTION PLUS REMOVAL OF OVARIES. CAUSES OF DEATH. APPRECIATION OF THE SEVERAL OPERATIONS. SYMPHYSIOTOMY, OR THE SIGAULTIAN OPERATION.

THE Cæsarean section is an operation by which the child is extracted through an incision made in the abdominal wall and the uterus.

The Cæsarean section occupies a doubtful place between conservative and sacrificial obstetrics. It is conservative at least in design. It is not necessarily fatal either to mother or child. If the operation could be done at a chosen moment, and so improved as greatly to increase the probability of saving the mother, then the already high probability of rescuing the child might turn the scale in favor of the Cæsarean section, and against embryotomy. Unfortunately, art has not yet reached this point. The mortality to mothers from Cæsarean section is still so great, whilst that from embryotomy in fitting cases is so small, that we are unable at present to raise the Cæsarean section to the rank of an elective operation. It is impossible to attain accurate data for estimating the risk to life caused by the Cæsarean section. It is certainly so great that no one undertaking it can reckon with any confidence upon a successful result. Pajot says[1]: "This operation has cost the lives of *all* the unhappy women who have undergone it in Paris, since the beginning of this century. And it is still practised!" For a hundred years there had not been a recovery after a Cæsarean section in Vienna. In Italy the old operation was almost always fatal. Chiara said that out of sixty-two cases operated on by Porro, Lazzati, Billi, and himself, only three recovered. Probably these figures give too gloomy a view. We have spent much labor upon general medical and obstetrical statistics, and have arrived at the conclusion that nothing is more untrustworthy or more misleading. We have, therefore, abstained, from encumbering this work with statistical tables. Those who take an interest in this mode of obscuring a clinical question will find material in Churchill and Charpentier. We will simply here reproduce from Schroeder a summary, drawn up in 1874, of Mayer's results of the operation in England, Germany, France, Belgium, Italy, and America. 1605 operations gave 54 per cent. recoveries. The proportion of recoveries is certainly not understated. And yet it is but fair to point out that it is not less certain that many deaths, occurring after Cæsarean section, were due to causes acting before the operation was performed, and only secondarily to the operation itself. Like things only should be compared. Rightly to estimate the mortality from Cæsarean section, we must weigh those cases only in which the operation was done at a selected time, and which were uncomplicated with other dangerous conditions.

To what extent is the terrible risk encountered by the mother balanced by the saving of infant life? This question does not admit of a precise answer. Keyser says the infant mortality is 30 per cent.; and this figure does not

[1] Preface to Robert Barnes's "Diseases of Women" (1875), French edition.

include the infants dying within a few days. Scanzoni ascertained the fate of 81 children out of 120 operations performed between 1841 and 1853; 53 children, or 60 per cent., were born alive. The mortality is certainly greater than in ordinary labor. Nor are we entitled to weigh infant life against maternal life. If the question be decided by the estimate formed of the relative value of the mother's and the infant's life, the answer must be in favor of the mother. If delivered by embryotomy her recovery is highly probable, and she may bear a living premature child hereafter. But the final argument is that it is the mother's inalienable right to be saved, even if that involve the sacrifice of her child. The operation is essentially one that is performed in the interest of the mother. It is an operation imposed by *necessity*, as the *only* means of effecting delivery. To accept it as one of *election*, it must be shown to be the *best* means of effecting delivery.

We have seen that embryotomy is practicable with a reasonable prospect of saving the mother when the conjugate diameter is reduced to 1.75 or 2 inches. The Belgian school, as represented by Hyernaux, admits the Cæsarean section at 4 centim. = 1.5 inches. The opinions of older authors, who asked for 2.5 or 3 inches in the conjugate, must be taken with the qualifying allowance that they worked with defective embryotomy instruments. The improvements in these instruments, the limit of which we believe is not yet reached, has reduced within narrower compass the necessity for resorting to the Cæsarean section. Some men still contend that embryotomy cannot safely be performed with a contraction below 2.5 inches. We submit that this argument is entirely subjective; it applies simply to those who urge it. They cannot reasonably impose their own limit upon others possessed of greater skill.

THE CONDITIONS THAT RENDER THE CÆSAREAN SECTION NECESSARY.—The most frequent condition is deformity with contraction of the pelvis. The operation is justified when the contraction is such that we cannot hope to deliver the child *per vias naturales*, whole or mutilated, without great danger to the mother. The degree of contraction at which this occurs may be stated generally at 1.5 inches and below; at the higher limit of 1.5 inches the Cæsarean section comes into competition with embryotomy. But we may reasonably hope to carry the minimum to 1 inch. Cases may indeed occur in which a conjugate diameter of 2 inches may call for Cæsarean section if the pelvis be much distorted, so that the diagonal and transverse diameters offer insufficient compensation for the narrow conjugate. This is more especially the case when, as in osteomalacia, the cavity and outlet of the pelvis are also so contracted and rigid as to render the introduction and manipulation of instruments impossible. Extreme cases of rickets and spondylolisthesis sometimes render the operation necessary.

Abdominal and pelvic tumors may render the operation necessary. The most common are uterine fibroids, dermoid cysts, and ovarian cysts. When these block the pelvis, impeding the entry of the child, and cannot be dealt with by pushing them up out of the way or by tapping, the Cæsarean section may be the only alternative. And care should be taken to select this operation when there is reason to apprehend bursting or other serious injury of the tumor if the child were dragged past it through the normal passages. Fibroid tumors of the lower segment or neck of the uterus constitute a strong indication.

Dr. Sadler reported a case in which the operation became necessary from the pelvis being filled up with an enormous hydatid cyst springing from the liver. Cystic disease of the kidney might cause similar difficulty.

In certain cases of extrauterine gestation complicating uterine gestation, the abdominal section may offer the best solution.

Malignant disease of the lower segment of the uterus may also call for the operation. Labor at term, involving, perhaps, laceration to an unknown extent, and certainly serious crushing of the morbid tissue, presents in most cases greater danger than Cæsarean section.

If cancer invade the cervix, the surrounding tissues being still free—and the case may come under observation before the child is viable—there are three alternatives: (1) We may consider it most judicious to let things go on to term; or (2) the diseased cervix may be amputated by the wire-écraseur, by galvanic cautery wire or the knife; or (3) the entire uterus may be amputated through an abdominal section. Spencer Wells published a successful case.[1] If the condition is first observed when the child is viable, the Cæsarean section after the manner of Porro is indicated.

Similar arguments apply to some cases of fibro-myoma of the uterus.

Rupture of the uterus, as we have seen, is best met by the abdominal section. The like rule holds when there is atresia of the cervix uteri and vagina, which cannot without great danger be encountered by embryotomy.

It is also indicated in some cases when the mother is *in extremis*, or even dead, in the hope of rescuing a living child. Intimately associated with this question is the length of time a child *in utero* may survive its mother. No precise answer can be given to this. The fœtus in the lower animals will live some time if the ovum is not opened. It seems not improbable that a modified degree of placental circulation may continue for some little time after the mother's circulation has been stopped; and it is certain that the fœtus may survive for some little time in a state of asphyxia or suspended animation, capable of restoration on being brought into the air. Children have been extracted alive ten minutes after the mother's death. Wrisberg cites three cases of infants born enclosed in the membranes; they lived—one seven minutes, and the two others nine minutes while thus enveloped. Brunton relates a case[1] of a seven months' child expelled in intact membranes, from which it was taken out alive after an estimated interval of fifteen minutes.

The chance of rescuing the child by Cæsarean section *post mortem* will be much influenced by the circumstances attending the mother's death. If she dies from phthisis or other exhaustive disease, it may survive some minutes. If she dies from hemorrhage or rupture of the uterus, the child's death is likely to precede that of the mother.

The Cæsarean section after death comes into competition with forced delivery *per vias naturales*. Sometimes, if the cervix is dilated, the child may be extracted by turning as quickly as by Cæsarean section. Turning has the advantages of being less likely to shock the friends, and it may be practised when the section would be rejected. The view that forced labor may be practised on the moribund has found favor in the Italian school. Belluzzi thus saved two children. Amongst Roman Catholics it is held to be imperative to deliver the child in order that it may be baptized.

THE OPERATIONS.—There are four varieties of the Cæsarean section: A. The Cæsarean section simple. B. Porro's operation. C. Laparo-elytrotomy. D. Cæsarean section, plus the removal of the ovaries.

A. *The Cæsarean Section Simple.*—Questions preliminary to the operation: *What is the best time to select?* It is assumed that the operation is unavoidable. Sometimes all choice is denied us, or the range of time is very limited. The indications once recognized, it ought not to be delayed. It is a misfortune, tending fatally to compromise success, to be obliged to operate when the structures that have to be wounded are so worn and injured that the power

[1] Med.-Chir. Trans [2] Obst. Trans., vol. xiii.

of reaction and repair is seriously reduced; when the blood is deteriorated by the products of nervous and muscular overwork.

If the patient come under observation early in pregnancy, we have the double opportunity of inducing labor, avoiding the operation, and of selecting the time for its performance should it be unavoidable. Is it an advantage to operate during labor, waiting upon Nature to give the signal? It has been held that the epoch which Nature has fixed for labor presents the most favorable conditions for the process. The whole organism is better prepared. The uterine muscles having acquired full development, and contraction having actually set in, it seems reasonable to anticipate that the wound made in the uterus will close better, and the processes attending delivery will be more safely carried out. Ludwig Winckel,[1] who has had great experience in the operation, says the most favorable time is the end of the second stage, when the membranes are ready to burst. He advises not to rupture the membranes. The escape of liquor amnii into the abdomen does no harm, and the extraction of the child is more easy if the membranes are kept entire until the moment of seizing the child. But, admitting spontaneous labor at term to be a favoring condition, may not labor artificially induced be equally favoring? It has been argued that by operating before term, the uterus, taken at a period prior to the highest degree of degeneration of its muscular fibres, would heal better. This is a physiological error; the degree of fatty change in the mature uterus is no impediment to repair. There are too many examples of union after section by the knife, and even after rupture, to admit of a doubt as to the capacity of the mature uterus to repair itself. Then, on the other hand, clinical experience proves that the uterus is capable of complete repair at the seventh or eighth month of gestation.

We may then very properly consider whether, assuming things to be equal *quoàd* the uterus, there may not be other circumstances that may turn the scale in favor of premature delivery. In some cases such circumstances undoubtedly exist.

The general conclusions may be summed up as follows: There are certain cases in which we have no choice of time; we must operate on the instant emergency. There are cases, such as extreme distortion or malignant disease, in which—the induction of labor at a time to admit of delivery *per vias naturales* having passed by—it is better, in the interest of mother and child, to wait for the natural term of gestation. Looking at the probability of the operation proving fatal, it is clearly better to give the woman another month or two of life.

Upon the whole, the best course is to select a time as near the natural term of gestation as possible. Shall we start the labor as a preparation for the operation? The weight of reason seems to be in favor of operating upon a uterus in the act of labor. The first step, then, will be to pass up an elastic bougie into the uterus over-night, and to proceed to the operation next day. If the os uteri is not open more than enough to allow a finger to pass, it will be useful to dilate it a little more with the caoutchouc bag, No. 2. This will probably excite further uterine action, and it will secure a free outlet for discharges from the uterus.

THE INSTRUMENTS AND ASSISTANTS.—The instruments required are a catheter, a sharp bistoury, a bistoury having a blunt end, a director such as is used for ovariotomy, artery forceps and ligatures, needles, silk or catgut sutures for the uterine wound, the usual antiseptic apparatus and dressings, solution of perchloride of iron to arrest hemorrhage from the placental site,

[1] Monatsschr. f. Geburtsk., 1863.

a galvanic battery to excite uterine contraction, and a drainage tube. Assistants: A skilled assistant should stand on the side of the patient opposite to the operator. Another should be free to hand instruments and assist in sponging. The anæsthesia is, of course, entrusted to a special assistant. A nurse or two will complete the necessary staff.

THE OPERATION.—A. CÆSAREAN SECTION SIMPLE.—The patient is laid on a table on her back, head and shoulders slightly raised. The operator stands on the patient's right. The catheter is passed. If the case be one of osteomalacia, explore for the last time to ascertain if the pelvis can be opened up by the hand.

It is desirable to determine by auscultation the seat of attachment of the placenta. Pfeiffer noticed that a peculiar thrill or vibration marked the seat of the placenta, and this sign may receive confirmation by feeling the part bulging a little on the uterine spheroid.

The abdominal incision is then made in the linea alba from a little above the umbilicus to within two inches of the symphysis pubis. It is best extended upwards and downwards to the requisite extent by the strong ovariotomy scissors. Assistants support the abdominal wall on either side to prevent the escape of intestine. The uterus, being brought centrally to correspond with the abdominal incision, is incised in the middle line, sparing the fundus and lower segment as much as possible, as these parts are not so well adapted to contract, and large vessels are more likely to be divided. Circular fibres predominating near the cervix tend to make the wound gape. Winckel describes a manœuvre very useful in guarding against the bulging of intestine. He gets an assistant to hook a finger of each hand in the upper and lower angle of the uterine wound, and, lifting them up, fixes them in contact with the corresponding ends of the abdominal wound. This shuts in the intestine effectually, and helps to prevent blood from running into the abdominal cavity.

If the placenta is found directly behind the wound, the hand of the operator is insinuated between the placenta and the uterine wall, detaching it until the edge is felt. Then the membranes are pierced, and *the child is seized by the feet.* Sometimes in extraction the neck is tightly grasped by the uterine wound. If the constriction does not soon yield, it is better to extend the incision than to drag overmuch, or it may be best to deliver the head first.

Removal of Placenta.—If the uterus contract and cast off the placenta, the removal by hand is simple. But if the uterus remain flaccid, the peeling-off by the hand is sure to be attended by free hemorrhage. In this case it is better not to hurry this stage, but to wait a while, as we do after ordinary labor, to allow the uterus to recover power, and to excite it, if necessary, by galvanism or the ether spray. The placenta may be squeezed out by the two hands.

When child and placenta are removed, attention is required to watch the bleeding. This may take place from the cut sinuses in the uterine walls and from the placental site. Hemorrhage from the cut surfaces Fancourt Barnes found to be effectually controlled by Sydney Jones's ovariotomy clips. If hemorrhage persist from the placental site, it will be necessary to swab it with perchloride of iron. Hemorrhage is further controlled by pressure upon the uterus.

Before closing the uterine wound, thrust a probang, armed with a bit of sponge, through the cervix, to insure free communication between the uterine cavity and the vagina.

The Closure of the Wound.—When the bleeding has ceased, and the peritoneal cavity has been swabbed out, we have to consider the question of

applying sutures to the uterine wound. It has been observed that in many fatal cases the edges of the wound have been gaping and flaccid. But in most of these cases the operation had been done on women exhausted by protracted labor. On the other hand, in women operated upon at a selected time, the uterus commonly contracts well. But we must remember that, just as we find it to happen in ordinary post-partum hemorrhage, the uterus may relax again after having been apparently well contracted. Many recoveries have happened without stitching the uterine wound. Winckel says he has never lost a case from hemorrhage, and he has not stitched the wound. The "suture sanglante," so called, was used by Lebas de Mouilleron in 1769. Simpson, Spencer Wells, and others have used it, but the patients died.

Another principle has been followed—that is, to stitch the uterus and unite it by the sutures to the abdominal walls. Hicks and Tarnier each treated a case on this principle. Effusion was prevented. Uterine suture should meet the following conditions: It should stop hemorrhage from the cut surfaces of the uterus; it should secure fair apposition of the two lips of the uterine wound; it should keep the anterior wall of the uterus in apposition with the abdominal wall, so as to favor adhesion without dragging. This last condition is not so essential as the first two. Interrupted silk sutures, such as are used to stitch up wounded intestines, are best.

The abdominal wound is united by the interrupted suture of silk or silver wire as in ovariotomy.

After-treatment.—An opium suppository should be applied. Perfect repose and light nourishment are essential. The dressings should rarely be removed under five or six days. The sutures had better be left until the seventh or eighth day. The bowels may be relieved by enema of soap on the fourth day. It is necessary to wear a well-fitting firm abdominal belt for some months.

B. Porro's Operation.—The most remarkable fact in the history of the Cæsarean section is the introduction of the method known as Porro's. Cavallini, in 1768, instituted experiments on the removal of the pregnant uterus in bitches and ewes. Blundell made similar experiments, three out of four rabbits recovering. He says (1828): "In speculative moments I have sometimes felt inclined to persuade myself that the dangers of the Cæsarean operation might be considerably diminished by the total removal of the uterus. Perhaps this method of operating may prove an eminent and valuable improvement." Has subsequent history realized the idea? Porro, in 1876, first carried the proposal into execution by deliberately performing utero-ovarian amputation during Cæsarean section. His memoir, "Della amputazione utero-ovarica come complemento di taglio Cesareo," 1876, is epochal. He has had four recoveries out of five operations.

It consists in the removal of the uterus and appendages by amputation through the cervix after extracting the child. It is claimed for it that it gives greater security against hemorrhage; there is no uterine wound to heal; there is less risk of septicæmia; and there is security against future pregnancy. The operation is performed by (1) making an abdominal incision; (2) laying open the uterus: (3) and extracting the child as in the ordinary Cæsarean section; then (4) drawing the emptied uterus out of the abdomen; (5) transfixing and ligating the uterus just below the os internum by Cintrat's or Koeberlé's *serre-nœud;* (6) amputating the uterus with the ovaries and tubes just above the *serre-nœud;* (7) securing the stump outside the abdominal wound by transfixing needles. The general rules of antiseptic surgery are observed. (8) The abdominal wound is closed as in ovariotomy.

In a case performed by Fancourt Barnes, all hemorrhage from the wound of the uterus was effectually controlled by seizing the cut edges with Sydney Jones's ovariotomy-clamps, so that very little blood need be lost.

Dr. Godson collected[1] 138 cases. These gave 77 deaths against 61 recoveries—a very formidable result. We are unable to say whether this contrasts favorably or not with that of the simple Cæsarean section. The indications for the operation are generally the same. In Godson's case, which ended in recovery, the pelvis had been smashed in childhood. In Fancourt Barnes's case, the operation was called for by the blocking of the pelvis by an immovable dermoid cyst. The patient lived four days, and would probably have survived but for the changes undergone in the tumor, which was fixed to the pelvic wall.

One question not yet settled is whether it is better to secure the stump outside the abdomen or to drop it inside. Dr. Goode,[2] of Sydney, had a successful issue after the intraperitoneal method. But the results of this plan in ordinary hysterotomy are not encouraging.

Müller's modification of Porro consists in drawing out the whole uterus, with its contents, through the abdominal wound. Thus drawn out, the ligature is secured round the stump before the uterus is opened and the child extracted.

C. The operation of *laparo-elytrotomy* (λαπάρα, the flanks; ἔλυτρον, the vagina; and τομή, a cutting), revived by Dr. Gaillard Thomas, was originally performed by Von Ritgen and Baudelocque. It consists in an incision, usually on the right side, through the abdominal wall, from above the spine of the pubes to above the anterior superior spine of the ilium—that is, along Poupart's ligament. The peritoneum is then raised, the fundus uteri is tilted down to the opposite side, the os uteri tilted up, and an incision made through the vaginal wall on to a probe or staff in the vagina. The child is then extracted through the os uteri and the vaginal wound. The wound in the flank is then united by sutures. Dr. Garrigues states that for the performance of this operation five assistants are desirable, four indispensable. The operation has been done eight times. Of these cases six were done in America by three operators: Drs. Thomas, Skene, and Gillette. In England, up to the present time, Drs. Hime and Edis alone have resorted to the operation,—in both instances unsuccessfully. Of Dr. Thomas's two cases, one recovered. Of Dr. Skene's three cases, two recovered. Dr. Gillette's one case recovered. The mortality has therefore been four in eight cases. The chief drawback to the operation is the difficulty—we were almost saying the impossibility—in preventing injury to the bladder during the delivery of the child. In Dr. Edis's case, in the British Lying-in Hospital, the child weighed 7 lbs. 10 oz., and yet the bladder was ruptured. In four out of the eight cases just mentioned the bladder was injured. The epigastric artery may be wounded; this, however, is easily ligated. An important objection is that the mother may again become pregnant, and have to undergo similar dangers.

D. Cæsarean Section plus Removal of the Ovaries.—The removal of the ovaries obviates the risk of future pregnancy. It appears to be the natural complement of the Cæsarean section. It is desirable to remove the Fallopian tubes at the same time. The parts are embraced in a clamp, and the stumps secured by ligatures. In other respects the operation is the same as the simple section.

To furnish indications in the conduct of the Cæsarean section, it is desirable to keep in mind the more common *causes of death*. These are:

1. If the operation is performed as the last resource after protracted

[1] Brit. Med. Journ., 1844. [2] Ibid., 1884.

attempts to deliver by other means, the woman is apt to sink from shock and exhaustion in a few hours. If she survive beyond a few hours, there is the risk of hemorrhage, of metritis, peritonitis, gangrene, septicæmia. It may be said that the prospect of recovery when the operation is performed under these circumstances is very small.

2. If the operation is performed at a selected time, the woman encounters the *shock* of the operation with unimpaired strength. Still the shock is great. It affects different persons in different degrees. It is an uncertain element of danger, and must probably ever perplex all calculation as to the result of the Cæsarean section in any particular case.

3. The next danger is *hemorrhage*. This is often associated with prostration as cause and as effect. It may come on within a few hours. It may flow from the placental site and from the uterine wound. It may kill by rapid anæmia, and by causing irritation of the peritoneum. Closure of the wound by suture and inducing contraction of the uterus, should obviate the hemorrhage. If not, styptics must be applied.

4. *Secondary Shock and Peritonitis.*—Secondary shock may precede peritonitis. Intense pain, even tenderness on pressure, rapid small pulse, accelerated and impeded breathing, suggest the diagnosis of peritonitis. This condition Robert Barnes described as "abdominal shock." If at this stage the patient die and be examined, probably no trace of peritonitis, as revealed by redness or effusion, is discovered. Peritonitis may be manifest on the day following the operation.

5. The next danger is *septicæmic puerperal fever.*

6. In addition to the dangers incident to the operation and to the puerperal state, there is the danger inherent to the disease which rendered the operation necessary, especially in the case of cancer.

Winckel says that osteomalacia is much more unfavorable than rickets in connection with Cæsarean section.

The uterus often contracts adhesions with the abdominal wall during repair. These adhesions do not appear to entail serious inconvenience, and should pregnancy again occur, and the Cæsarean section be again necessary, they render the operation less dangerous (Meigs). The peritoneal cavity is shut off; the incision through the abdominal wall leads directly through the adhesions to the uterus. Thus some of the usual dangers are eliminated. This result would be favored by uterine suture and uniting the uterus to the abdominal wall. On the other hand, no adhesions may be found, and the uterine wound may heal so completely that years afterwards no trace of cicatrix is found. Again, there may remain a marked cicatrix, free from adhesions, as in Newman's case, figured in the "Obstetrical Operations."

Several cases are known in which the operation has been performed twice, thrice, and even four times on the same woman. These cases seem to indicate a special tolerance in the subjects. They cannot be accepted as evidence, absolute or cumulative and statistical, in reduction of the danger of the operation. The following history by Frerichs is instructive.[1] He performed the section on account of contracted pelvis. Mother and child recovered. Again pregnant, premature labor was induced at about the eighth month. When labor had begun, collapse set in; the uterus had ruptured. The child was removed by abdominal section. Vomiting caused extrusion of the intestines. To effect reposition numerous pricks were made in them with a bistoury, and much thin pappy matter escaped. The intestines were then replaced and the wound closed. How many women would be as tolerant?

[1] Nederl. Tijdschr. v. Geneeskunde, 1858.

COMPARATIVE APPRECIATION OF THE SEVERAL OPERATIONS.—Shock is inherent to all. It is greater in Porro's operation. Hemorrhage is especially dangerous in the Cæsarean section simple; it may be practically excluded in Porro's operation. The danger of escape of blood or irritating matters into the peritoneum is serious in the simple section, and excluded in Porro's method. Müller's modification of Porro's operation is of doubtful value. Little or nothing is saved in hemorrhage. It has been found difficult to draw the full uterus through a very free abdominal wound. Greater shock is entailed, Laparo-elytrotomy has the advantage of not opening the peritoneal cavity; but if the cervix uteri is not dilated enough, time may be lost in dilating before the child can be extracted. The child's chance is less, the mother's not greater than in Porro's operation. And there is the serious risk of injuring the bladder. Cæsarean section plus the removal of the ovaries has the obvious advantage, like Porro's method, of excluding the danger of future pregnancies; it entails less mutilation, and if we could be secure against hemorrhage it would in many cases be preferable. Porro's method is especially indicated when there is disease of the uterus, or when tumor blocks the pelvis.

SYMPHYSIOTOMY—THE SIGAULTIAN OPERATION—has been devised as an alternative for the Cæsarean section. This proceeding is based upon the fact of the natural relaxation of the pelvic joints in pregnancy and labor. If it be admitted that the pelvic ring expands a little under the distending action of the child in passing, might not a similar end be attained by dividing the symphysis pubis, and thus opening the pelvis in a manner similar to what takes place in guinea-pigs?

The operation is never mentioned in English works unless to be condemned. It has at various times been regarded as obsolete. The subject is well discussed by Scanzoni and by Lovati (*Del parto meccanico*). Sigault maintained that an inch was gained by it. Leroy gained two and a half inches. Baudelocque and Desgranges in their experiments gained a space between the pubic surfaces of two and a half inches. They say that every half inch of distance between the pubic surfaces gives one line of conjugate diameter—therefore two inches give four lines; then, if the parietal protuberance be made to project into the interpubic space, two lines more are gained; the oblique diameter gains eight lines; the transverse gains half the distance between the pubic bones—that is, one inch. The operation might therefore be available in cases where a gain of six lines will enable a live child to pass, or where a head impacted in the brim might be liberated without perforation. In either case extraction by forceps would still be necessary.

The operation has in recent years been revived in Italy. Morisani gives statistics of fifty cases performed on forty-eight women between 1868 and 1881; the principal operators being Novi, Martini, and Morisani. Forty mothers and forty-one children survived. He considers that it is less dangerous than embryotomy. The deaths of mothers are not more numerous, and the children saved are a clear gain. It may be objected that the deaths from embryotomy are much overstated. His method is as follows: He uses a small crotchet-shaped knife, curved, and cutting on its concave edge; it is known as the *falcetta di Galbiati*. An incision of from 8 to 5 centim. is made just above the symphysis pubis. The articulation is gradually reached, the *falcetta* is slipped along the posterior surface of the symphysis, and when the lower edge of the symphysis is reached, the cutting concavity of the instrument is hooked under the interpubic cartilage, which is then cut through from below upwards. If the uterine contractions are strong, the expulsion

of the child is allowed to take place spontaneously. If they are feeble, the forceps is applied. Lastly, the wound is dressed, and immobility of the pelvis is secured by an appropriate bandage.

Symphysiotomy, notwithstanding this favorable report, will probably not make way in practice as an alternative for the Cæsarean section or for embryotomy. Scanzoni says the only case in which it is justifiable is where the mother dies in labor, the child being partly born, and extrication difficult without enlargement of the pelvis.

The mother will probably remain lame.

CHAPTER XXX.

THE PREMATURE INDUCTION OF LABOR: DEFINITION; HISTORICAL NOTE; CONDITIONS UNDER WHICH CARRIED OUT; PROCESS AND OPERATION; PROVOCATIVE AND ACCELERATIVE MEANS; INDICATIONS FOR OPERATION; DISTINCTION BETWEEN INDUCTION OF ABORTION AND PREMATURE LABOR; MODIFICATIONS OF OPERATION; IN PELVIC DEFORMITY; URGENT DANGER OF MOTHER; CONVULSIONS, CHOREA, HEART AND LUNG DISEASE; HEMORRHAGES; TO SAVE THE CHILD; INTRAUTERINE DISEASE; ETHICAL CASES; CONCLUSION.

By the premature induction of labor we are carried back within the range of conservative obstetrics. By this operation we anticipate some of the dangers which mother and child would encounter in labor at term.

The recognition of the operation as a legitimate resource of conservative obstetrics dates from 1756, when, says Denman, "there was a consultation of the most eminent men at that time in London to consider the moral rectitude of, and the advantages which might be expected from, this practice." It met with their general approbation. It has since encountered much opposition, chiefly in Roman Catholic countries, science contending in the interest of humanity from her point of view, and religion from hers. The general tendency has been to show that these views are not really antagonistic; and thus the operation now generally commands the sanction of science and religion.

Definitions.—The premature induction of labor is the artificial arrest of gestation when seven months are completed, when the child has reached viability. The induction of abortion is the artificial arrest of gestation in the earlier months before the child is viable.

The first operation is designed to rescue both mother and child, or at least the child, when it is more especially in danger. The second operation is designed solely in the interest of the mother.

It is important to consider *the general conditions under which the operations have to be carried out.*

1. The fitness of the general system to enter upon labor and puerpery. The nervous, circulatory, and glandular systems are imperfectly developed. This imperfect preparation we must accept. In reality the system is generally fairly competent to carry through the duty imposed upon it.

2. The uterus is immature. This involves imperfect contractile power, and imperfect dilatability of the cervix uteri.

3. The defect of uterine development is partly compensated by the child being smaller and more plastic. On the other hand, abnormal presentations are more frequent. Most of the accidents that may complicate labor and puerpery at term may complicate premature labor and abortion.

We must, then, bear in mind that when labor is provoked, the system, generally, and the uterus are taken by surprise.

Relation of the Proceeding to the Mechanism of Labor.—By labor at seven months, contraction of the pelvis according to advancing degrees, spontaneous labor may supersede the forceps, the forceps may supersede turning, turning craniotomy, craniotomy the Cæsarean section, and the Cæsarean section may be eliminated.

The motive principle is to bring the two factors, the body to be expelled, and the resisting force, into approximate relation.

Relation to the Systemic Condition.—1. Developmental attraction of blood to the pelvis is stopped. 2. Vascular tension is reduced. 3. Nervous tension is reduced. Hence morbid processes which are aggravated by high nervous and vascular tension are eased.

The Process of Artificial Labor.—It may be divided into two distinct stages: (1) Provocative; (2) accelerative.

1. *Provocative Measures.*—Action has been too exclusively limited to provocation. The provocative measures may be divided into (*a*) medicinal; (*b*) topical or instrumental. (*a*) Medicinal agents act mainly upon the spinal centre, some to a certain extent directly upon the uterine irritability. The principal medicinal agents are ergot, savin, quinia, hamamelis, borax, cinnamon. We will not dwell upon these, since their action is extremely uncertain. It is, however, well to remember that all these drugs act much more surely upon women in hot climates. (*b*) Some agents evoke the energies of the diastaltic system by stimulating various peripheral nerves. Such are rectal injections, the vaginal douche, the colpeurynter or water-bag in the vagina, the plug, or tampon, or water-bags in the cervix uteri, the separation of the membranes, intrauterine douche, the evacuation of the liquor amnii, injection of carbonic acid into the uterus, the introduction of bougies into the body of the uterus, faradization; the irritation of the breasts by sinapisms, or the air-pump. Some of these agents act also partly by direct mechanical force, dilating the vagina and cervix. This is the case with the tampon and the water-bags.

Appreciation of these Methods.—Faradization, at first sight, would seem to be the most scientific. Herder suggested this method of causing the uterus to expel its contents in 1803. In 1844, Hörninger and Jacoby brought on labor by it. Radford showed its value in labor and in controlling hemorrhage. In 1853, Robert Barnes published a memoir on this subject. He succeeded in three cases in provoking labor by it. But he found the method tedious, and sometimes distressing to the patient. One pole was applied to the cervix uteri, the other on the abdomen over the uterus. On making the contact the bladder would contract, thus showing the influence upon the hollow organs. Recently, Dr. Kilner has revived the method, and in his hands, with improved apparatus, it seems to promise better results.[1]

The Douche, Vaginal and Uterine.—The vaginal douche is known as Kiwisch's plan. It consists in playing a stream of water against the cervix uteri. It is often tedious, and not free from danger. It requires to be repeated at intervals during several days. It is liable to cause congestion of the lower segment of the uterus. Serious shock, metritis, and death have followed. It was adopted by Tyler Smith, until he encountered a fatal result.

The intrauterine douche is sometimes spoken of as Kiwisch's plan. It was recommended by Schweighaüser in 1825, and practised by Cohen in 1846. It is known in Germany as Cohen's method. It consists in passing a tube fairly into the uterine cavity. Different operators have passed the tube to different distances. Although more certain to provoke labor, it is even more dangerous than the vaginal douche. Fatal cases have been recorded by Lazzati, Salmon, Depaul, Blot, Tarnier, Esterlé, Ulrich, J. C. Dalton, and others. The references are given in the "Obstetric Operations," 3d ed. The cause of death appears in some cases to have been shock; in others, air has got into the veins and heart.

[1] Obst. Trans., 1884.

Of course, no degree of efficiency could justify the use of a method fraught with such terrible danger. But it does not possess even the merit of certainty. Lazzati tried it in thirty-six cases, and found that from one to twelve injections were required, and that the time expended varied from one to fourteen days. It was also found that a large proportion of children were lost. The douche therefore, vaginal or uterine, ought to be absolutely condemned. We repeat this emphatically, because the method is still taught and practised.

It must be noted, however, that Mr. James[1] and Lazarewitch,[2] contending that the seat of greatest irritability of the uterus is the fundus, recommended that the tube should be carried to that region, and then to inject. James injected about eight ounces of cold water. Of eight children only two were stillborn. Lazarewitch reported twelve cases. It may be admitted that this method is more sure than other modes of applying the douche; but the cases are too few to prove that it is safe. We feel sure that if it be at all frequently adopted, fatal catastrophes will ensue. It may, moreover, be doubted whether, in cases managed on the principle of applying irritation to the fundus uteri, the injection of water is not superfluous. The passage of a catheter five or six inches into the uterus detaches the membranes along its course, and this is usually quite enough to provoke labor. Why not, then, rest satisfied with that part of the proceeding which is safe and efficient, and discard that part which is superfluous and dangerous?

It is instructive to compare the histories of some cases of intrauterine injection with those of intrauterine hemorrhage from detachment of placenta. Sudden severe pain in the abdomen at the seat of effusion, shivering, vomiting, collapse, are observed in both cases. In the case of hemorrhage, these symptoms are certainly not in proportion to, or due alone to, the loss of blood. They seem to be the direct effect of injury to the uterus from sudden distention of fibre. The uterus will grow to keep pace with developmental stimulus of a body contained in it, but it will not stretch to accommodate several cubic inches of fluid suddenly thrown into it. Yet this is what it is called upon to do when water is injected. If the water escape as fast as it enters, the shock may be avoided; but then the operation is liable to fail in inducing labor.

The injection of *carbonic acid gas or even common air* seems more dangerous still. Carbonic acid excites muscle to contract. Hence the motive of its application. Scanzoni relates two fatal cases from injection of carbonic acid. J. Y. Simpson relates one where the patient died in a few minutes after the injection of common air.

Another method of provoking labor consists in dilating or irritating the cervix uteri. Many contrivances have been proposed. The principal are the sponge-tent, the laminaria-tent, the elastic air or water-bag. Labor sometimes, indeed, follows their use. But the result is extremely uncertain, and often tedious. In most cases some further means, as rupturing the membranes, will be necessary. The laminaria-tent is, however, useful in expediting the dilatation and evacuation of the uterus in some cases of abortion. It must, however, be stated that pyæmic symptons have resulted from the foul discharges caused by the tents. This accident might, perhaps, be obviated by the use of tents charged with antiseptic agents. Many instruments made to expand on the principle of urethral dilators have been adapted to the purpose of dilating the cervix. As a means of inducing labor they are not to be trusted.

The method known as Hamilton's, which consists in *detaching the mem-*

[1] Lancet, 1861. [2] Obst. Trans., 1868.

branes of the ovum from the lower segment of the uterus, has the recommendation of safety; but it is uncertain in its operation.

The *introduction of a bougie into the uterus*, sometimes called Krause's method, is of all methods that which combines certainty and safety in the highest degree. A bougie is slowly passed up between the uterine wall and the membranes, until the point is presumed to reach the fundus, the most irritable part of the uterus. Two things are done: the membranes are detached along the course of the bougie; and the presence of the bougie acts as an excitant. The bougie should be passed at least six or seven inches through the os. Probably in many cases in which the proceeding has failed, the bougie had only penetrated a short way. By passing the bougie, lubricated, gently, letting it worm its way, it will naturally run between the membranes and the uterine wall where there is least resistance, turning round the edge of the placenta. The bougie must be left *in situ* for several hours. Spiegelberg, however, says that there is danger of air getting into the uterine cavity, and of infection, and this whether a catheter or a solid bougie be used. We always use an elastic bougie, well soaked in carbolic solution. We have never met with any accident, and still adhere to the recommendation of the method we gave in the "Obstetric Operations" many years ago.

Puncturing the membranes is practised in two ways. The direct puncture at the point opposite the os uteri is probably the oldest method of inducing labor. It is the surest. It is not in itself dangerous. The immediate effect of draining off the liquor amnii is to cause concentric collapse of the uterine walls, diminishing its cavity in adaptation to its diminished contents. This probably involves some disturbance in the utero-placental circulation. The parts of the fœtus come into contact with the uterine wall. Hence uterine contraction is promoted both by diastaltic excitation, and by the impulse given by the concentric collapse.

In certain cases this plan of direct puncture is the most convenient, as where the object is to lessen the bulk of the uterus and insure labor quickly. But it is open to the following objection: it is an inversion of the natural order of parturient events. Some uterine action, lubrication, and expansion of the cervix ought to precede the evacuation of liquor amnii. If this order be not observed, the child is apt to be driven down upon the unyielding cervix, and the uterus, still contracting concentrically, compresses the child and kills it. And this is all the more likely to happen in premature labor, from the greater liability to shoulder presentation and descent of the funis.

This objection is to some extent obviated by a modification of the method. Hopkins recommended to pass the sound some distance between the ovum and the uterine walls, and then to tap the amniotic sac at a point remote from the os. In this way the liquor amnii would escape gradually. It is an important improvement, and it is still adopted in this country and in Germany.

Vaginal Dilatation.—In 1842 Hüter described a method of exciting labor by placing a calf's bladder smeared with oil of hyoscyamus in the vagina and distending it with warm water. This proceeding he repeated every day until labor set in, which usually happened in from three to seven days. Braun substituted a caoutchouc bladder, to which he gave the name of *colpeurynter*. This was adopted by several German professors. Another form of vaginal dilator is the air-pessary of Gariel. Accidents, of a fatal character in some instances, have followed the use of these instruments. But we cannot think that danger is inherent in the method if carefully carried out. Still, the principle of vaginal dilatation is unsound.

The successful application of fluid pressure as a means of dilating the cervix is mainly due to Robert Barnes, whose water-bags have long been in extensive use. Keiller and Jardine Murray had previously employed caoutchouc bags. But these appear to have been introduced inside the cavity of the uterus proper. Murray published[1] a case of placenta prævia. Having first detached the placenta from the lower zone on Barnes's plan, he introduced a flattened air-pessary between the wall of the uterus, and the presenting surface of the placenta, and inflated it by a syringe. In the same year Dr. Storer published a case in which he introduced "the uterine dilator" within the cavity of the uterus. He especially insisted that the dilatation was "from above downwards." Tarnier also (1862) contrived an intrauterine dilator designed to expand the lower segment of the uterus. This is a distinctly different principle from that which Barnes worked upon. He pointed out certain faults inherent in all elastic bags which expand inside the uterus, even more serious than those which mark the vaginal dilators or Braun's colpeurynter. It is the cervix that wants dilating. A bag that expands below it in the vagina, or above it in the uterus, can only act upon it indirectly, imperfectly, and uncertainly. The uterine dilator, moreover, is unsafe; during dilatation it must stretch the uterine wall at the risk of injury and shock, and it is very likely to displace the head from the os uteri. We have never seen the dilators of Keiller and Murray, but from the accounts published we are justified in regarding them as unfit to dilate the cervix. The form now used (see Fig. 167) was perfected, after much difficulty from instrument makers, before the models of Tarnier, Keiller, and others had been made known. The constriction in the middle is seized by the cervix, whilst the two expanding ends serve to prevent the bag from slipping up into the uterus, or down into the vagina. It imitates in its action very closely the bag of liquor amnii. By its aid the cervix may be expanded sufficiently to admit of delivery within an hour, although it is generally desirable to proceed more slowly. In cases of placenta prævia we have effected adequate dilatation in half an hour, when time was precious.

The Proceeding Recommended.—Having discussed the various methods of provoking labor, we are now in a position to select the most safe, convenient, and efficient. The plan we have successfully practised for many years is the following: First, overnight, pass an elastic bougie, No. 9 or 10, lubricated with carbolized vaseline, as far as it will go into the uterus, and coil up the remainder in the fundus of the vagina. It will thus keep *in situ*. By next morning some uterine action will have set in. The uterine neck and the vagina will be found soft and freely lubricated with mucus, and some expansion of the cervix will have taken place. The bougie should be kept in its place until the child is ready to pass. This is *provocation*. In the afternoon, at an appointed time, we may proceed, if desirable, to *accelerative* measures.

Before rupturing the membranes, adapt a binder to the abdomen, and let this be tightened so as to keep the head in close apposition to the cervix. This will often prevent the cord from being washed down by the rush of liquor amnii. The cervix is then dilated by the medium, or large, water-bag until it will admit three or four fingers. Then rupture the membranes, and before all the liquor amnii has escaped, introduce the water-bag again, and expand until the uterus is open for the passage of the child. If the presentation is natural, if there is room, and if there are pains, leave the rest to Nature, simply watching the progress of the labor. If these conditions are not present, and one or other is likely to be wanting, proceed with accel-

[1] Med. Times and Gaz., 1859.

erative measures—that is, to the forceps or turning, or, in cases where the passage of a live child is hopeless, to craniotomy.

By pursuing this method we may anticipate with great accuracy the term of the labor. Twenty-four hours in all, counting from the insertion of the bougie, should see the completion of the labor. But the proceeding must vary according to the conditions of the case. In many cases it is desirable, it being clear that the child is not imperilled by delay, to allow dilatation and expulsion to be effected as far as possible spontaneously. We must recollect that safety is best secured by obtaining such dilatation of the soft parts that the child may pass easily and quickly. But if urgency dictate, labor may be accomplished at a predetermined hour and at one sitting.

INDICATIONS FOR THE INDUCTION OF LABOR.—*It is strictly a medical question*, ruled by considerations for the interest of (1) the mother and child; (2) of the mother; (3) of the child. Gestation may be divided into two parts. During the first part, terminating at six and a half to seven months, or at the end of 180 or 200 days, it is scarcely probable that a viable child will be born. To induce labor within this period is really to induce abortion. It is therefore only done under the pressure of conditions that preclude waiting until the child is viable, and out of regard solely to the safety of the mother. Between 200 and 230 days is a stage of very doubtful viability, and the physician will still endeavor to postpone interference until after the latter date, when the operation may be undertaken with more confidence of saving the offspring as well as the mother.

The selection of the time is determined by obstetric conditions that will be pointed out. But a certain range is generally permitted. Storer, in a memoir on Uterine Ebb, as a Factor in Pelvic Surgery,[1] says: "We may wish to induce labor, and to our surprise may again and again introduce the sound fairly to the fundus, sweeping the membranes from the uterine wall, but without the slightest result. We shall then discover that we have selected the uterine ebb. We wait for a few days till the flow has again commenced, and we find the labor induced by the most trifling cause." Hence, we should select when we can a menstrual epoch.

In a large proportion of cases we may, within certain limits, select our time. For example, when there is moderate pelvic contraction, admitting of the safe passage of a child a little below the full size, we may be justified in waiting until the end of eight months, say 250 days. The difficulty is to determine the starting-point of the pregnancy. There is a probable range of error of fifteen days. If we count fifteen days too many, we reduce the duration of gestation to 235 days—that is, we may fall within the period of doubtful viability. If, on the other hand, we count fifteen days too few, we run the risk of having to deal with a child too large to pass the narrow pelvis alive.

The best way, perhaps, of steering between these two rocks is to reckon the pregnancy from the day after the cessation of the last menstrual epoch, the most probable time of conception. Count 230 days from that epoch, and add twenty days for a margin of safety. This will leave a full month to complete the development of the child. The cases are few, if all the resources for accelerating labor are turned to account, in which a child of 250 days may not be delivered alive. But if we fall upon a child of 215 days or less, the chances of its survival are small. The error of procrastination is generally of less moment than the error of anticipation. Of course, if the pelvic contraction is great, say to 2.5 inches, it will be prudent not to calcu-

[1] Edinb. Med. Journ., 1877.

late beyond 240 days, but rather to incur the risk of bringing forth a non-viable child.

Ahlfeld proposes the following scheme for estimating the size of the fœtus, and thence the stage of gestation. The long axis of the fœtus when flexed *in utero*, he says, is nearly half the entire length when extended. Thus, if we measure the axis *in utero* by a pelvimeter, one point of which is applied by the vagina to the fœtal head, and the other on the fundus uteri where the breech is felt, we get the first element in the problem, and doubling the length so obtained, we get the total length of the extended child, the second element. Now, if we assume a definite relation of length of child to the period of gestation, we have the index required. For example, let the axis obtained be 9 inches, $9 \times 2 = 18$ inches, the total length of the child. This corresponds to the thirty-first to the thirty-fourth week of gestation. The range of probable error is too great to admit of much reliance upon this method. There are four factors, if not more, which must be determined with some precision in order to base trustworthy calculations: the size of the child, the development of the cranium, the date of the gestation, and the dimensions and shape of the pelvis. Seldom can one of these factors be determined with precision; we shall certainly fail in determining all. And if we could determine all, we could not count upon a fixed correlation.

We may first enumerate those conditions which in the interest of the mother demand the interruption of gestation during the first part—that is, *the induction of abortion.* These are: A. Certain cases of extreme contraction in the bony or soft parts—*e. g.*, distortion and narrowing of the pelvis below 2 inches; the encroachment of considerable tumors, especially if they are unyielding, upon the pelvic canal; some cases of advancing cystic disease of the ovary; great contraction from cicatrices of the cervix uteri and vagina, not admitting of free dilatation; some cases of carcinoma of the uterus or vagina; some tumors of the uterus; retroflexion or retroversion of the uterus that cannot be reduced, or when uræmia complicates; fixing of the uterus from adhesions.

B. Certain cases of urgent disease, depending upon and complicating gestation—*e. g.*, obstinate vomiting with progressive emaciation, and a pulse persistent for some days above 120; some cases of advancing jaundice with diarrhœa; some cases of albuminuria, especially if convulsions attend; some cases of insanity or of chorea; hemorrhages producing marked anæmia, especially if due to placenta prævia; some cases of heart-disease or lung-disease, attended with extreme dyspnœa, such as aneurism, hypertrophy, valvular disease, œdema of the lungs, pleurisy, pneumonia.

Under many of the conditions cited, Nature herself will be likely to induce abortion. If we have been fortunate enough to carry the patient over the first part of gestation, we may still be compelled to induce labor.

Our experience leads us to conclude that in cases of urgent disease there is more frequent occasion to regret having delayed the operation too long than having had recourse to it too soon. When through obstinate vomiting, for example, nutrition has long been arrested, the starved tissues, craving for supplies and falling into disintegration, feed the blood with degraded and noxious materials; the system feeds upon itself and poisons itself; the poisoned blood irritates the nervous centres, and these centres, wrought to a state of extreme irritability, respond to the slightest peripheral, uterine, or emotional excitation. All nervous energy is thus diverted from its natural destination, and exhausted in destructive morbid action. Irritative fever ensues; the pulse rises to 140 or more. No organ is capable of performing its functions properly, for the pabulum of life is cut off at the very source. At this point labor, whether it occur spontaneously or be induced by art,

comes too late. The tissues are altered, the powers are impaired beyond recovery, and death soon follows delivery.

The question of inducing abortion being past, we have to enumerate *the conditions which call for the induction of labor.* The most generally recognized indication is such a degree of pelvic deformity as forbids the prospect of delivering a live child at term. In these cases the proceeding is an alternative for Cæsarean section and craniotomy.

In many cases we are left to determine upon the expediency of inducing labor by the history of antecedent labors. Where craniotomy has been performed on account of contracted pelvis clearly recognized, there can be little ground for doubt. But why should one or more children be sacrificed in order to teach the physician that the pelvis is too small? A woman pregnant for the first time is entitled to the benefit of the operation, if it be known that her pelvis is too small. The difficulty is to know this. The opportunity of making an obstetric estimate of the pelvis before labor is rarely afforded. The first labor at term is the common practical test of a woman's aptitude for childbearing.

The object to be attained is the reduction of one of the factors of labor into due relation with the other. The pelvis being a fixed quantity, the alternative is to bring the child through it at an early stage of development. The table (p. 779) shows how the scale of operations, arranged in the order of their severity as applied at term, may be slided down, so that when applied to labor at seven months, spontaneous labor supersedes the forceps, the forceps turning, turning craniotomy, and craniotomy the Cæsarean section, so that the Cæsarean section is eliminated.

Incidentally, a mode of seeking to reduce the bulk of the child may be mentioned. It is *starving the patient*, in the hope of arresting the development of the child. No reliance can be placed upon this method. Sedgwick relates[1] a case of obstinate vomiting, in which nutrition was reduced to the lowest point compatible with life. Gestation ended in labor at term, when a healthy child was born quite unaffected by the severe regimen of its mother. It seems that the organism *in utero* will attract to itself all it can get, even at the sacrifice of the parent. This is often illustrated in phthisical women, who, emaciated to the last degree, almost dying of exhaustion, bring forth plump children.

The modifications of the proceedings to be adopted in different cases are: 1. In the case of pelvic deformity not admitting of the birth of a live child at term. Three degrees of contraction must be considered:

The *first*, or least, degree—say, giving a conjugate of 3.5 inches. In such a case a child of seven or eight months' development will probably pass without much difficulty at seven months. Here it may be enough to provoke the labor, and watch its course.

The *second* degree, giving a conjugate of 3 inches. Here, unless the child be very small or timely aid be given, its head may be delayed so long in the brim that it will be lost. It will be proper to provoke labor by inserting the elastic bougie over night; to accelerate labor by dilating the cervix, rupturing the membranes, applying the forceps, or turning.

The *third* degree, conjugate being below 3 inches, may possibly admit the forceps: but it may be necessary to turn, or to perforate.

By inducing labor we get a head smaller and more plastic. Ossification proceeds rapidly during the last month of gestation. The advantage of increased plasticity is especially seen in those cases in which turning is resorted to. The course to pursue is as follows: If the uterus act with suf-

[1] St. Thomas's Hospital Reports, 1876.

ficient power, and the pelvic contraction be not so great as to impede the passage of the child's head, and the cord do not fall through, watch and let Nature do her work. But if the head be delayed, or the cord fall through, we must intervene. We may first try the forceps. But in most cases turning is better. The explanation is this: The smaller and more plastic head is caught at the smaller or bitemporal diameter between the projecting promontory and the symphysis pubis; the jutting promontory leaves abundant room on either side in the sacro-iliac recess for the cord to lie protected from pressure; and if care be taken that the cervix uteri be adequately expanded, the head comes through so quickly that the danger of asphyxia is not great. The mode of turning deserves attention. The object being to secure quick delivery, the soft passages must be well prepared. We might turn by the bipolar method, without passing more than two fingers through the os uteri. But we have found it better to pass the greater part of the hand through the cervix to grasp the further knee. The cervix that will admit the hand will probably permit the ready transit of the child. We thus test and secure adequate dilatation.

When turning is completed, extraction must follow. It should be done gently, drawing upon the one leg until the breech has passed the outlet; the extraction of the trunk should be slow; a loop of cord should be drawn down to take off tension. If the arms run up by the sides of the head, they must be quickly liberated. The rules given for this operation are of extreme importance in this case (see p. 823). When the arms are liberated, another difficulty arises: the neck of the child is in danger of being gripped in the ring of the cervix. This is the moment for acceleration. The two legs are held at the ankles by the left hand, whilst the right-hand fingers are crutched over the back of the neck. The head is sure to enter the contracted brim in the transverse diameter. It has then to take the course of Barnes's curve. Traction must, therefore, be at first carefully backwards in the direction of this curve so as to bring the head round and under the promontory. When it has cleared the strait, and is in the pelvis, the occiput commonly comes forward, and traction is changed to the direction of Carus's curve to bring the head through the outlet. Unless rigorous attention is paid to this rule, so much time may be lost as to imperil the success of the operation. In cases of extreme deformity, in which it is difficult to perforate or to seize a leg, if labor has been induced at six months, the fœtus may still pass if we give time. After making a reasonable effort to snare a foot by manipulation and the wire-écraseur, if we leave the uterus to act for twelve hours or more, the child having perished and become moulded, some part of it—a foot or a shoulder—will come within reach. This can be drawn down; the head can be perforated, and then delivery is effected by traction. The placenta should also, if not following readily, be left a little while, and then squeezed out. In this way, Robert Barnes delivered in St. Thomas's Hospital a six months' fœtus in a case of great osteomalacic deformity, in which it was impossible to get two fingers through the brim. The woman did well. This course applies especially to cases of osteomalacia in which some amount of yielding or unfolding of the pelvic bones may be obtained.

In other cases of extreme deformity, delivery may be effected after craniotomy, removal of the cranial vault, flattening of the remains of the bones upon the basis cranii, and extraction in the discoid state (see p. 849).

Certain cases of urgent distress of the mother produced or aggravated by high vascular and nervous tension may call for the induction of labor. Such are uncontrollable vomiting; advancing jaundice; albuminuria, especially if attended by convulsions; some cases of insanity or chorea; hemorrhage, especially if from placenta prævia or of the "accidental" kind; diseases of

the heart or lungs entailing urgent dyspnœa. These cases have all been carefully discussed in the chapter on the "Diseases of Gestation."

It is useful to insist again upon the case of convulsions. Prompt action is imperative. It has been seen over and over again that the convulsions have ceased soon after the uterus has been emptied. The nervous and vascular tension quickly fall. Everything proves that the convulsions are due to conditions arising out of the pregnancy. What then more logical than to terminate the pregnancy? Yet experience suggests caution as to the mode of acting. In not a few cases labor has failed to put an end to the convulsions. In other cases death has followed labor, whether this have occurred spontaneously or have been induced. Is the unfortunate issue the consequence of procrastination in inducing labor, or of over-haste or want of precaution in the mode of proceeding? It is due sometimes to one cause, sometimes to the other.

The question of inducing labor before the actual outbreak of convulsions does not often come practically before us. If we are brought face to face with the prealbuminuric stage or the albuminuric stage, the question must be carefully weighed. In some such cases the induction of labor would be a wise proceeding. When convulsions have broken out, it is rarely wise to hesitate. Is the operation to be carried out *citissimè*? Is it to be done slowly and deliberately? The latter principle is the more judicious. The proceedings should involve the least possible operative interference. In the first place, all should be conducted under chloroform. The membranes should be punctured. This at once lessens the bulk of the uterus, and diminishes the pressure upon the abdominal vessels. The cervix should next be carefully dilated by the hydrostatic dilators; and then, according to circumstances, we may wait a while, or accelerate the delivery by forceps, turning, or even by craniotomy.

A similar course will be proper in cases of *chorea* or urgent distress from *heart disease*. In the case of dangerous vomiting in the early months, it will be useful as a preliminary measure to insert a laminaria tent into the cervix.

In retroversion of the uterus, irreducible and with urgent symptoms, the puncture of the membranes is the proper course. Immediate relief is gained by the concentric diminution of the volume of the uterus.

Fixing of the uterus by perimetric adhesions may indicate induction of abortion or labor. Laceration or other mischief might arise during the development of the uterus. A case in illustration occurred at St. Bartholomew's Hospital.[1] Adhesions may, however, disappear under gradual stretching.

There are cases in which the induction of labor, or rather the emptying of the uterus, is indicated in order to *remove a dead child*. Usually expulsive action is set up spontaneously within a week of the death of the fœtus. It will rarely be postponed beyond three weeks; but occasionally a much longer time has elapsed. There is a tendency to postpone the act of labor until the expiration of nine months. And then there is the case of "missed labor," in which the labor may be indefinitely postponed. This subject has been discussed in Chapter XII. With the death of the fœtus, nervous and vascular tension fall. The uterus will commonly have lost much of its contractility and other properties peculiar to pregnancy. Simple provocative means may be totally inefficient. The cervix may have to be dilated by faggots of laminaria tents, and the child extracted piecemeal, perhaps at several sittings.

[1] Lancet, 1871.

There are cases in which the indication is *simply or primarily to save the child.* Certain conditions tend to kill the child before the term of gestation. If we can bring the child into the world before the anticipated period of its death *in utero*, we may hope, by bringing it under fresh influences, to save it. Denman gives a case of a woman who lost two children about the eighth month, a rigor preceding. He suggested the induction of labor. Various diseases endanger the fœtus as they advance. Such are hydrocephalus, syphilis, fatty degeneration, hypertrophy, dropsy of the placenta. The child, if rescued alive, may be successfully treated and reared.

The prognosis for the mother in fitting cases free from accidental complications is good, probably as good as that of ordinary labor. The prospect of the child is very fair, but it cannot be predicted with any confidence. The chances of error in the date of gestation, in the estimate of its viability, and the unusual conditions attending delivery are so many, that the best efforts may be baffled. And then a considerable proportion of the children born alive perish within a short time after birth from immaturity. Hence the most vigilant care is necessary in the treatment of the child. The *couveuse* or an equivalent should be prepared. Warm air to breathe, warmth to the surface, are essential. And we should be prepared to resuscitate from asphyxia.

Anticipation of the term of gestation is also indicated when a woman has brought forth unusually large or unduly ossified children; and especially when it is suspected that gestation is protracted.

There are cases in which the wisest medical and ethical judgment is required. Some difficult cases may be stated. A woman pregnant about six months is dying of phthisis. Would it prolong her life or improve her condition if labor were induced? Should we be justified in sacrificing the child with that object? Or state another case: A woman threatened with imminent death by phthisis has attained the time when the fœtus is viable: shall we be justified in inducing labor, and perhaps accelerating her death, for the sake of rescuing her child? The relations of phthisis to gestation have been discussed in the chapter on the Diseases of Gestation. It was long thought and some people still believe, that pregnancy is antagonistic to the advance of phthisis. If this were true, the course would be obvious. Let the pregnancy alone. We believe, however, that pregnancy exerts no beneficial influence. Still clinical experience gives strong evidence in favor of expectation. Pregnancy is commonly less trying to a phthisical patient than labor and puerpery. The puerperal process throws such an increase of work upon the circulation, that the system often breaks down under the trial. Again, the prognosis in phthisis, even in cases apparently the most desperate, is often open to grave fallacy. Who has not seen patients, whose days were counted, survive for months, even for years? In the interest, then, of mother and child, it is not wise to take precipitately the irrevocable step.

There are yet other cases in which the medical and ethical elements tax the judgment. Thus a woman is pregnant by a syphilized and maniacal husband. She dreads bringing into the world a child that may inherit these diseases.

Another case: A woman has had two pregnancies; both produced twins and flooding so severe as nearly to cost her life. Pregnant a third time, she asks to have abortion induced, urging that she is going to a colony beyond reach of skilled physicians.

Another case: A lady had puerperal mania; she recovered, and had insanity when not pregnant. This attack yielded quickly under rectification of uterine displacement; again pregnant, insanity returned at five months. Should labor be induced?

These cases all occurred in practice. In one case of recurrent puerperal insanity, Spencer Wells removed the ovaries in order to obviate the risk of another pregnancy and the probable concomitant insanity. It is difficult to contest the legitimacy of this proceeding. But several nice questions arise out of it. 1. It is assumed that another pregnancy will bring back insanity, and that without pregnancy the probability is sufficiently strong that she will not lapse into insanity. But ovariotomy simple has on several occasions been quickly followed by insanity. Then, again, oöphorectomy is not free from danger to life. Supposing the chances of death under the operation, and of recurrence of insanity if the ovaries are not removed, to be equal, are we justified in pitting life against insanity? 2. Is there no other way of avoiding pregnancy? Abstinence on the part of the husband is surely more reasonable than mutilating the wife. At the same time it must be remembered that oöphorectomy is justified by clinical experience as a life-saving resource against hemorrhage and other dangers connected with uterine fibromyoma.

The advance of gynecological knowledge imports new views into obstetric practice, and compels us to revise laws that seemed immutably settled.

The new questions thus forced upon our attention add irresistible weight to the rule urged by Denman and his contemporaries, namely, not to undertake the induction of abortion or labor without a formal and deliberate consultation. When we reflect upon the many and grave medical, legal, and moral points involved in the arbitrary interruption of gestation, we shall see abundant reasons for seeking counsel to avoid possible clinical error, and for sharing serious professional and social responsibility.

With one more reflection we conclude this subject and this work. Women who are suffering under the trials, physical and social, of pregnancy are apt to think that they have a claim to the application of the resources of science to relieve them. This belief may be honest; it may be inspired by fear that overpowers reason and conscience. Whatever the motive, whatever the circumstances, the physician to whom the suggestion is made should meet it by at once proposing a consultation. Thus a complete revision of all the factors of the problem, full deliberation, and well-balanced judgment will be insured.

In this way he will set the question in all its gravity in the clearest light before those who consult him. He will show them that a step so important can alone be justified on the strict rules of medical science, guided by law social and divine; that the rules so based are designed in the best interests of the patient herself. And so will the physician, in acquitting himself of his duty to the State, to his profession, and to the patient, give proof of his conviction that medicine in its application to the relief of suffering humanity knows no law but that of Right.

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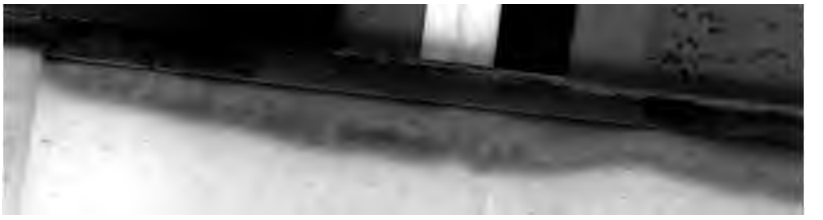

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